VOL. 23

DECEMBER, 1938

NO. 12

The Welding Engineer

MEMBER

Associated Business Papers
Audit Bureau of Circulations
American Welding Society
International Acetylene Association

G. H. MACKENZIE
President and Treasurer

RALPH S. KENRICK
Editor

M. S. HENDRICKS
Promotion Manager

» «

Eastern Representative:
T. E. DEPEW, 1834 Broadway, New York, N. Y.
Tel. Columbus 5-7843.

Western Representative:
L. C. MONROE, 608 South Dearborn Street, Chicago, Ill. Tel. Webster 7134.

Pacific Coast Representative:
W. R. McINTYRE, 446 Western Pacific Bldg., Los Angeles, Calif. Tel. Prospect 0565.

» «

Published on the 15th of each month by The Welding Engineer Publishing Company, 608 South Dearborn Street, Chicago, Illinois. Telephone Webster 7134

Advertising copy must be received not later than the 5th of each month.

IN THIS ISSUE

Our Front Cover

"New 6000-HP. Diesel-Electric Locomotive for Seaboard Air Line"—said to be world's most powerful passenger locomotive (a welded job)—went into service December 15th, on the "Orange Blossom Special" hauling standard Pullman equipment between Washington, D. C. and Miami, Fla.—Photo, courtesy of Electro-Motive Corp., La Grange, Ill.

A Welded Bridge "Ghost Story" (Editorial) 15

Design and Preparation of Parts for Hard-Facing Applications (E. E. LeVan) 17

Welding Data to Help the Fabricator Using Nickel-Clad Steel 19

Flame-Cut Shapes and Arc Welding Are Cutting Fabrication Costs 22

Helpful Pointers Which Will Aid the Success of a Commercial Weldery (A. E. Gibson) 26

Long Carbon Arc Welding of Copper and Copper Alloys (W. C. Swift) 30

Technique of Arc Welding (Roy Owens) 34

New Product Developments 36

News of the Industry 38

» «

M.I.T. Dedicates New Welded Wind Tunnel 21

Whiting Corp. Uses Welded Assemblies for Cranes 22

R. G. Le Tourneau Inc. Welds Earth-Moving Equipment 23

Swenson Evaporators and Rotary Drum Filters 23

New Welding School at Westinghuse 25

New Product Developments 36

News of the Industry 38

Personals 40

A.W.S. Activities 40

Future Meetings 40

Trade News 40

Foreign News 42

Current Reviews 42

Recent Patents 44

Trade Literature 45

Classified Page 46

Subscription, payable in advance: United States and possessions, and Canada, $3 a year; Foreign Countries, $4 a year; Single copy, domestic, 25 cents; Single copy, foreign, 35 cents. Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

FOREIGN REPRESENTATIVES: AUSTRALIA and NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand; GREAT BRITAIN—A. D. Baynes, 6, Mordaunt House, Larkhall, Clapham, London, S. W. 8, England; SOUTH AFRICA—J. W. Arnison, 35a Victoria Avenue, Benoni, Transvaal, South Africa; JAPAN—Maruzen Company, Ltd., 6, Nihonbashi, Tori-Nichome, Tokyo, Japan; U. S. S. R.—Mesdunarodnaja Kniga, Kusnezki Most 18, Moscow, U. S. S. R.

For Low-current Work

NEW A-C UNIT, 150-Ampere Size

Here's the answer to those who have been asking for a reasonably priced alternating-current arc welder of this size from which safe, dependable service can be obtained day in and day out.

For instance, it has woven, spun-glass insulation throughout, and all internal connections are solidly brazed to stand up under the heat of heavy loads.

Choice of two open-circuit voltages is provided so that all types of a-c electrodes can be used. Incidentally, the new G-E electrode, Type W-25, is among the best a-c electrodes available.

Continuous, stepless control of welding current is provided over the entire range of 30 to 180 amperes.

Totally enclosed in a strong, cylindrical, sheet-steel case, the entire unit meets the requirements of the latest standards of the Underwriters' Laboratories, Inc., and has been tested and listed under its Re-examination Service.

NEW D-C SET, 150-Ampere Size

"A man has got to actually try that set to believe it could be possible," is the way one operator described the satisfaction he obtained by using this new G-E welder.

And there is real justification for such enthusiasm because this new small set provides the same outstanding performance with bare, lightly coated, or heavily coated electrodes which has always distinguished General Electric d-c single-operator arc welders in the larger sizes—in fact, it is a small copy of the same fundamental split-pole-generator design.

Excellent mechanical stability has been obtained by a compact horizontal design—the unit occupies less than 2½ square feet of floor space. The rotor is dynamically balanced for smooth operation. Both ball bearings are horizontally mounted and sealed to assure proper, clean lubrication for long periods without attention.

Isothermic overload protection permits maximum safe overloads to be carried without harm and without unnecessary interruptions. There are many other money-making features, too.

But the easiest way to appreciate the outstanding dollar value you can obtain by purchasing either of these new arc welders is to try them. Call or write the nearest G-E arc-welding distributor or G-E sales office today for a trial, or for further information regarding these new units or any equipment for modern arc welding. General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

140-85

A Welded Bridge "Ghost Story"

By HAROLD S. CARD

A MOST PERSISTENT bear story circulating in the structural field concerns the collapse of a welded bridge in Belgium. There are individuals and groups who do not encourage the use of welding on bridges, and to them the simple fact that a welded bridge has been known to fail is a grand piece of gossip. Weld failures in important structures are so rare that the temptation is irresistible to avoid any inquiry as to how the welds behaved, whether the structure was overloaded, whether a riveted structure would have failed in the same circumstances, and to emphasize only that there was a welded structure and that it collapsed. After a few "retellings," a perfectly true and simple little yarn becomes garbled into an astounding testimony to the unreliability of welded construction for bridges; and the third, fourth and fifth tellers never do get around to reading either the original report or subsequent reports which may be in entirely different tone.

On March 14, 1938, an all-welded 244½-ft. single span bridge at Hasselt, Belgium, did collapse. In fact, it cracked into several pieces, a very thorough failure. Unfortunately it was reported to the technical press of this country that poor welding was generally thought to be the principal cause of the crack-up. According to later advices no such opinion seems to have been prevalent, but the combination of fact and fancy added up to a splendid bear story. As a further detail some of the early reports even fished that "old one" out of the bag about the parent metal having been embrittled by the welding process.

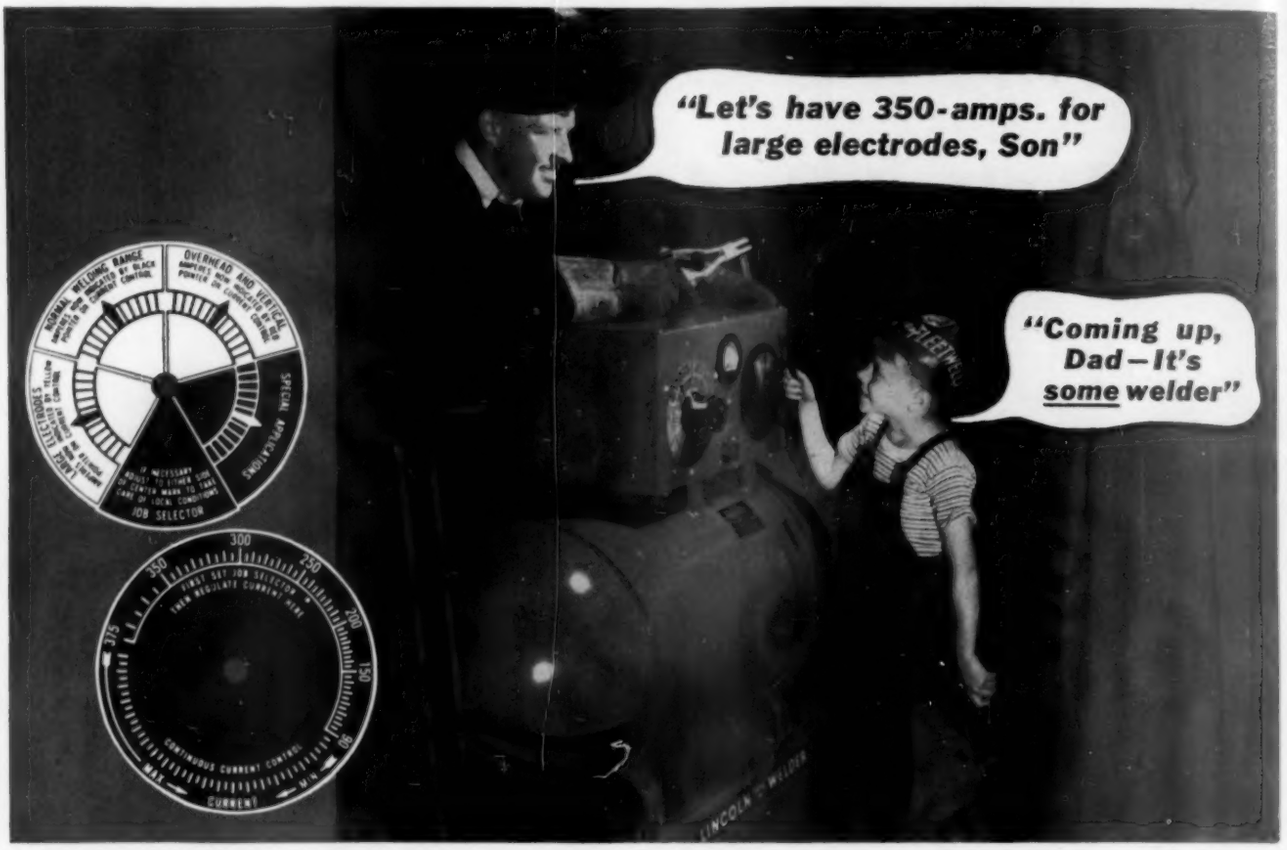
If poor welding had actually been as much as a contributing cause of the accident, the continued use of good welding on bridge structures would not properly be discredited thereby, because from the beginning of this application of the process, every responsible advocate of welding has emphasized the importance of proper design, correct technique and adequate inspection as safeguards against unsound metal or an excessive amount of residual stress. Welding experts who have visited and inspected the collapsed structure state that the welding was actually of poor quality—considerably below the grade of workmanship that is ordinarily demanded on bridge work.

The design has been subjected to some criticism by well-posted bridge engineers, and it will probably be considered by many of them to be an important contributing cause of the failure. This bridge, however, was one of more than 50 welded bridges of similar design that have been erected in Belgium during recent years, and none of the others has failed.

More significant than anything else so far reported in this case is the character of the parent metal itself. This was indicated to be extremely brittle. There was a striking lack of deformation in all of the members which either fractured or cracked. Some cracks which were photographed had quite the same forked appearance as a crack in a piece of poreclain. This does not occur in steel of structural quality, but only in brittle materials. Although it has not been officially established that the quality of the steel was an initial cause, the nature and location of the fractures point convincingly to the conclusion that even a poor job of welding behaved better than the steel that was used by the bridge builders.

Any suggestion that welding caused the brittleness is entirely unsound, and for two reasons. First, cracks and fractures occurred at much greater distances from the weld than any heat effect could travel. Second, it is inconceivable to anyone familiar with the operation of coated electrodes that a weld could be sufficiently overheated and quenched so rapidly as to cause brittleness, and still pass the most cursory inspection. Several cracks crossed the welds at right angles, whereas they would have proceeded along the weld or parallel to it if the welding process had actually been embrittling in its effect.

While awaiting the quantitative data which the official report of an investigating commission will undoubtedly provide, it would have been more accurate in earlier accounts to state that the welds, although not of the quality demanded in this country for all structures which have to carry important loads, could not be blamed for the Hasselt bridge failure, but, on the contrary, gave a very good account of themselves compared with the performance of parent material. Welding has no apologies to make in this case, because welding did not fail, nor, as far as has been reliably reported, did it cause the failure.



Self-Indicating control of the new "Shield-Arc" assures highest quality welds at lowest cost . . . on every job

● Easy? Take it from this 7-year-old "helper." He says, "Of course I can't weld . . . that takes training and experience . . . but I can set this new Lincoln. Everything is right on the dials."

Self-Indicating Job Selector and *Self-Indicating* Current Control . . . both continuous in operation . . . make it possible to set the new *"Shield-Arc"* for the right TYPE and SIZE of welding arc easily, quickly and positively. This assures maximum quality and maximum speed for every welding job, every time.

This new Lincoln Welder gives you these additional benefits:

WIDE RANGE. For all types of work and exceptionally wide range of welding current. *Dual Continuous Control* provides literally thousands of combinations of voltage and current.

FASTER WELDING. Larger electrodes can be used because the welder is *Self-Protected against burnout.*

MINIMIZED SPATTER. *Independent Excitation* contributes to this money saving feature.

STEADY ARC. Under all welding conditions. *Laminated Magnetic Circuit* contributes to the welder's remarkable arc stability.

. . . and 25 other cost-cutting features. Consult the nearest Lincoln office or mail the coupon.

LINCOLN

LARGEST MANUFACTURERS OF ARC WELDING EQUIPMENT IN THE WORLD

THE LINCOLN ELECTRIC CO., Dept. CC-553, Cleveland, O.

☐ Have a Lincoln man call to explain the new Self-Indicating *"Shield-Arc."* ☐ Send free bulletin 412-A.

Name _____ Position _____

Company _____

Address _____

City _____ State _____

Hard-faced cement clinker grinder ring, showing on inner surface beads of alloy as deposited. This is Fig. 7 in the author's series of captions.

Design and preparation of parts for

Hard-Facing Applications

★ Best results are obtained when parts are properly prepared before attempting to weld

By E. E. LEVAN
Haynes Stellite Co., Kokomo, Ind.

IN THE LAST few years, hard-facing has assumed an important position in the maintenance of many industries. It is now standard practice to apply wear-resistant alloys to such equipment as oil well drilling tools, cement grinder rings, lumber hog and chipper anvils, clay pug mill knives, aircraft motor valves, truck and bus valve seat inserts, hot-work dies and shear blades and many other parts subjected to abrasion and corrosion, hot or cold. The practice has become so widespread that certain definite procedures, including the proper design and preparation of the parts, welding techniques, and cooling and finishing methods, have been found most economical and efficient for each particular kind of wearing part.

In some cases, the preparation of the part is very simple, consisting only of the proper conditioning of the base metal by removing rust and scale preparatory to the hard-facing application. However, in most cases, it has been found expedient to grind or machine a groove, bevel or recess in the part, which is later filled with the hard-facing material.

In the case of simple shapes where tolerances are wide, a simple preparation will suffice. This is well illustrated by the application of Haynes Stellite to plowshares. Here, it is only necessary to draw-out the cutting edge and nose of the share to the proper shape and to clean the area to be hard-faced.

Road-grader blades, tractor treads, dipper bucket teeth, and similar parts of earth-moving machinery can all be hard-faced readily without extensive preparation. It must be emphasized, however, that proper cleaning of the base metal is absolutely necessary to obtain best results. It is important that all rust, scale, or other foreign substances should be removed from the area to be hard-faced, preferably by grinding. If grinding facilities are not available, the surface can be partially cleaned with a file or a wire brush, but this method often leaves scale or other foreign material which must later be floated out during the hard-facing operation.

Preparation for hard-facing involving simple grinding is well illustrated by the practice most commonly employed in connection with hard-facing

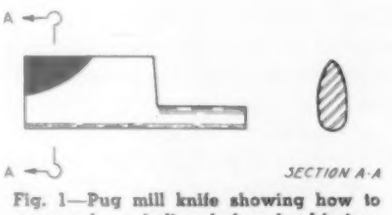


Fig. 1—Pug mill knife showing how to prepare by grinding before hard-facing.

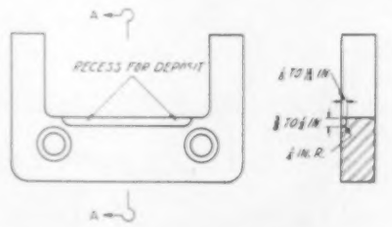


Fig. 2—Location of hard-facing material as applied to a "flying shear" blade.

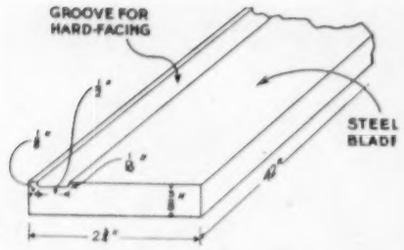


Fig. 3—Steel strip grooved in preparation for hard facing.

clay pug mill knives. A section on both sides of the knife and on the end of a standard cast steel pug knife should be rough ground, as indicated at "A" in Fig. 1. Thus the surface presents a clean area for the hard-facing deposit. Grinding here involves only the removal of a slight amount of metal which is later replaced by the hard-facing alloy. If the hard-facing alloy is deposited by the oxy-acetylene blowpipe, finishing of the deposit will not be necessary, since the alloy can be flowed on smoothly enough by this method for all practical purposes.

Controlling Warpage

Simple grooving of the base metal is illustrated by recommended practice for hard-facing hot flying-shear blades. Prior to the welding operation, a shear blade should be machined as shown in Fig. 2. A section about ⅛ to 3/16 in. deep and ⅜ to ½ in. wide, with the radius as shown, should be machined for a distance somewhat longer than the width of the billet to be sheared. As the shear blade shown in Fig. 2 is for a 4 in. billet, the length of the machined area in this case should be about 6 in. During the welding of parts such as this, which have a groove or bevel machined along a corner, a carbon plate can be placed against the edge to act as a mold for forming the deposited metal. This procedure prevents rounding off at the corner and thus facilitates the subsequent grinding of a sharp edge. The deposited alloy, when finish ground, will appear as shown in the shaded portion of Fig. 2.

For new parts requiring a sharp edge, such as roll scraper blades or shears for cutting thin sheet, hot or cold, an ingenious procedure has been worked out. The case of flour mill scrapers will be taken as an illustration. These scrapers, which when finished are 2½ in. wide and hard-faced on the top edge, are made from strip steel 2⅝ in. wide and ⅜ in. thick. The steel strips are cut to the proper length (in this case, 42 in.) and grooved on one side. As shown in Fig. 3 the groove is 1/16 in. deep and ½ in. wide, extending the full length of the blade ⅛ in. away from the edge.

During the hard-facing operation, a blade is clamped by the ends to a welding table. A block under the center of the blade gives a reverse curve against the side which is to be Haynes Stellited. In this case, this curve amounts to ¼ in. in every 14 in. of length—¾ in. for a 42 in. blade. The method of mounting is shown in Fig. 4. This manner of bending the strip during the welding operation has been found to completely eliminate any possibility of subsequent warpage. When the "C" clamps are removed, the bar returns to a flat position.

After the strip has cooled, the edge is machined off at a 30 deg. angle up to the under side of the Haynes Stellite. From this point it is ground to the desired contour. The metal removed by machining and grinding is indicated in Fig. 5. When finished, the strip appears in cross-section as shown in Fig. 6. It has been found that this method insures a sharp and yet substantial edge with a minimum waste of hard-facing alloy.

In hard-facing cement grinder rings, a standard practice in most cement plants, the principal point to be kept in mind is to eliminate warpage. New grinder rings are built-up in the following manner: First, they are placed on a pair of rollers and held in a vertical position with the chain of a

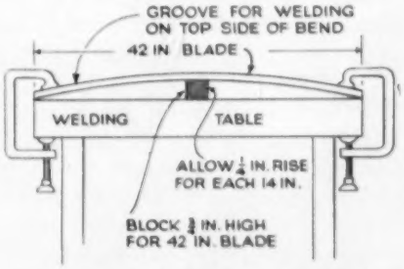


Fig. 4—Simple bending jig to hold steel blade during hard-facing operation.

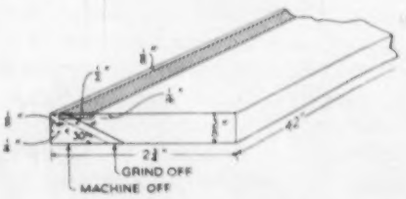


Fig. 5—Hard-faced steel blade illustrating method of machining and grinding.

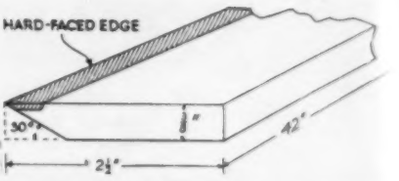


Fig. 6—Completed blade with cutting edge hard-faced and sharpened.

stationary travelling crane. A bead approximately 3/16 in. thick, ¾ in. wide and 6 in. long around the inner face of the ring is deposited along each edge by means of the metallic arc process. Next, beads approximately ⅛ in. thick and ¾ to 1½ in. wide are laid at right angles to the original edge beads, until the entire space between the edge beads is covered. Finally, a third series of beads is run parallel to and on top of the second series. The final bead should bring the deposit to an approximate depth of ¼ in.

Balancing Thermal Stresses

After one such 6 in. long section has been completed, the grinding ring should be turned 180 deg. and another section 6 in. long deposited in the same manner diametrically opposite the first one. Then the ring should be turned 90 deg. and a third 6-in. section deposited. Opposite this, the fourth section should be applied. By repeating this procedure, the entire inside face of the ring is gradually built-up with hard-facing material. When old rings are to be hard-faced, any deep pockets worn in the steel should first be filled in with a high strength steel welding rod. The ring is then hard-faced by means of the same method as are new ones.

The proper preparation of the part will provide better support for the hard-facing alloy. In addition, it will assure the use of a minimum quantity of hard-facing material exactly where it will be most useful. It will also facilitate finish grinding and minimize the possibility of imperfections. Thus, careful study as to the design of the part and the placing of the hard-facing material will aid materially in obtaining maximum efficiency and economy.

» «

THE BUREAU OF YARDS AND DOCKS, U. S. Navy Dept., has awarded a contract to the Moore Dry Docks Co., of Oakland, Calif., for the construction of structural steel framework for a foundry building, outside overhead crane runway, and crane runways for interior cranes at the Mare Island Navy Yard. Welding will be used extensively in this structure which will be 480 ft by 180 ft.

Fig. 1—Jacketed kettle used in processing of plastics. Has 20% nickel-clad steel outer jacket. All seams welded and ground smooth inside. (Struthers-Wells Co.)

Welding data to help the fabricator

Using Nickel-Clad Steel

★ Part 1—Strength of bond—Flame cutting procedure—Shop data for metallic arc welding—Preparation and rods to use

By F. P. HUSTON[1] and T. T. WATSON[2]

NICKEL-CLAD steel plate is protected on one side or both sides with a dense, homogeneous layer of pure nickel. The nickel cladding possesses the same chemical and physical properties as hot rolled or hot forged nickel in other forms. It is firmly and permanently bonded to the steel base plate and does not separate from it as a result of temperature change, pressure, vacuum, or deformation in forming.

The composite plate, clad either one side or both sides, is obtainable with various thicknesses of nickel. Standards of 5, 10, 15 and 20 per cent of the total thickness have been established. For example, the thickness of the nickel cladding on a ½ in. plate clad 10 per cent is .050 in. The 5 per cent cladding is produced only on plate ½ in. thick and heavier.

The conditions of corrosion, erosion, and abrasion will determine the selection of a thickness of cladding suitable for a particular service.

Convincing evidence of the strength of the nickel-to-steel bond in nickel-clad steel has been demonstrated by means of a specially prepared test bar so designed that the break at ultimate tensile strength occurred in the steel weld at 50,900 psi., thus indicating a strength of nickel-to-steel bond in excess of this figure.

Thick plates in gauges ¾ in. and heavier are gas cut almost as readily and at about the same speed as steel plate. The cut is made from the steel side with the torch head inclined away from the direction of travel at an angle

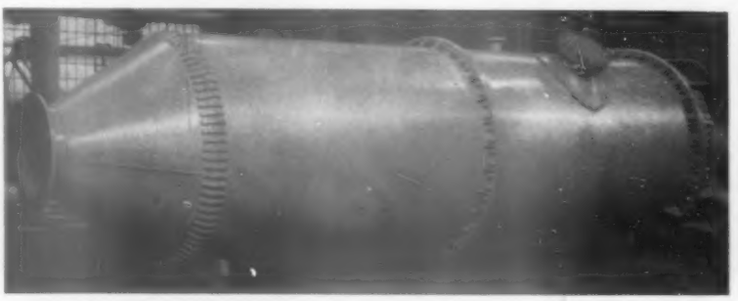


Fig. 2—High concentration evaporator of welded nickel-clad steel. (Struthers-Wells Co.)

[1] Development and Research Division—The International Nickel Co., Inc.

[2] Development and Service Metallurgist—Lukens Steel Co.

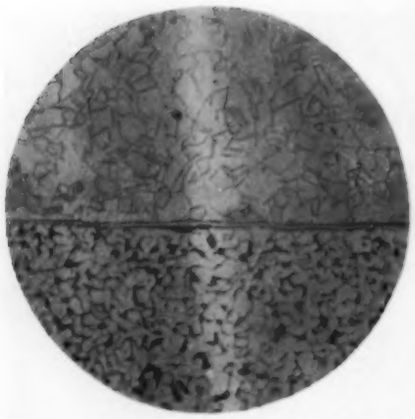


Fig. 3—Photomicrograph of bond between nickel cladding (top) and steel base (bottom). Magnified 100 times.

of about 10 deg. A tip one size larger than for steel should be used with about the same oxygen pressure. Plates thinner than ¼ in. may be gas cut in the same manner, but on the thinner gauges the scarf becomes rough and considerable grinding and chipping may be necessary. The oxygen pressure should be reduced to as much as about 25% of the pressure normally used for steel on plates ⅜ in. thick and under.

In cutting holes for fittings in fabricated tanks it is preferable to chip off the nickel cladding to the steel along the line of cut, and cut through from the nickel side.

Joints are made usually by welding, the nickel side being welded with nickel welding rod to obtain a continuous nickel surface which protects the steel base plate from corrosion at the joint. A description of recommended welding rods and welding practice follows. These joining methods have been used in the fabrication of hundreds of tons of nickel-clad steel equipment, the performance of which in service has demonstrated in a practical manner that properly made welds possess corrosion resistance entirely adequate for the purposes to which nickel-clad steel is adapted.

Metallic Arc Welding

Heavy steel plate is welded generally by the metallic arc method. Tank work which must be erected in the field, can be welded in any position, both on the steel and nickel sides.

In general, the most commonly used procedure in arc welding nickel-clad plate, particularly with beveled butt joints, is as follows: (1) assemble the vessel by tacking from the steel side; (2) complete the weld on the steel side; (3) chip out the nickel side of the butt joint, using a round nose gauge, to leave a clean groove as narrow as practical in which to deposit the nickel weld metal; and (4) deposit one or more beads of nickel weld metal into the chipped groove, to provide a continuous nickel interior surface.

Some shops, particularly those equipped for fabricating A.S.M.E. Code vessels, prefer to assemble the vessel by tacking from the steel side, welding completely from the nickel side, chipping to clean sound metal on the steel side, and completing the weld on the steel side. This method requires machined, beveled joints assembled with the lips of the bevel in tight contact and in close alignment.

The accustomed practices prevailing in the shop, including size and type of welding rod, current adjustment, and manipulation peculiar to individual operators, are used without important modifications in welding the steel side of the plate.

The skilled operator should have no difficulty in welding the nickel side. Operators inexperienced in the welding of nickel should study the instructions distributed by The International Nickel Co. on the welding of solid nickel plate, and then should make a few welds on scrap nickel-clad steel to become accustomed to the flow of nickel weld metal. The principal points to be observed in the preparation of the joints, assembly, and welding, are:

(1) The edges of the plate should be planed to give uniform alignment at the joint.

(2) Bevelled butt joints should be assembled with the edges of the bevel at the lip closely butted.

(3) On joints welded first from the steel side, the nickel side should be cleaned free from "icicles," slag, and heavy oxide. It is advisable to chip the seam with a round nose

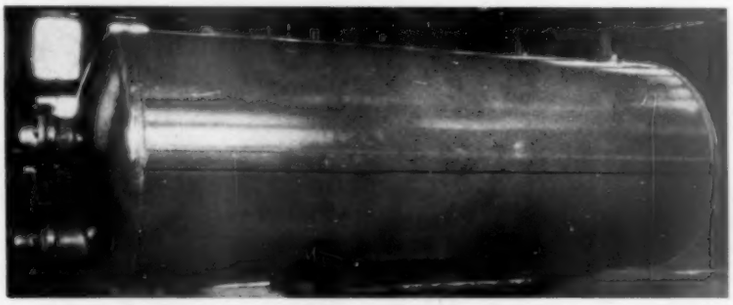


Fig. 4—Welded 1,000-gal. hot water heater tank. Shell and heads of 10% nickel clad. (Montreal Locomotive Works.)

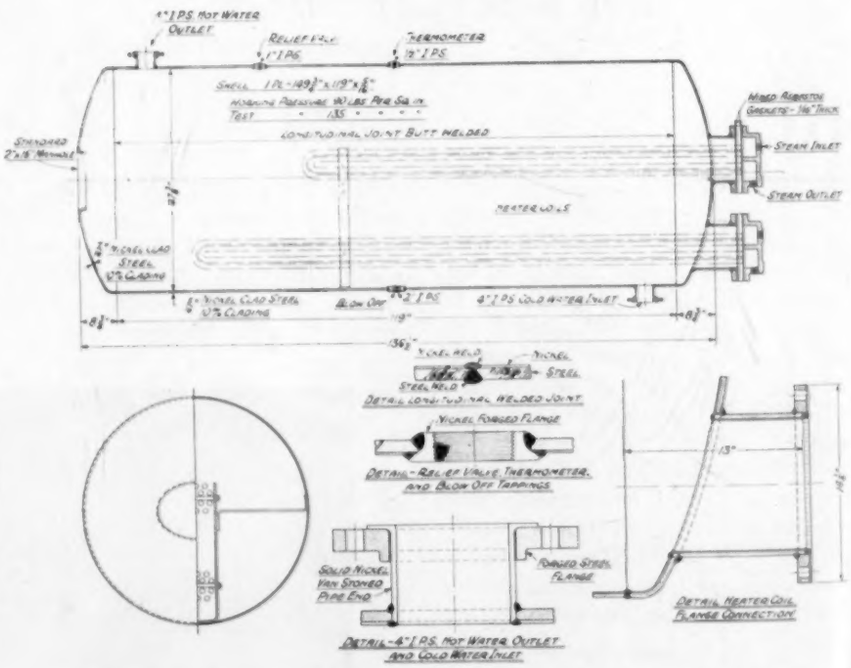


Fig. 5—Assembly and details of welded 1,000-gal. heater tank. Note flange and tapping connections.

chisel to a depth necessary to expose sound metal at the root of the steel weld.

On joints welded first from the nickel side, the tack welds should be chipped out on the steel side and the root of the bevel chipped to clean sound metal.

(4) Inco No. 135 nickel metallic arc welding electrodes should be used for welding the nickel side. These electrodes may be procured in sizes 3/32 in. to 3/16 in. diameter by 18 in. long, packed in five pound bundles. For most work a ⅛ in. or 5/32 in. electrode will be satisfactory.

(5) The operator should make trial welds with reversed polarity at several current values, and select the amperage that best suits the nature of the work and his own manipulative methods.

(6) A short arc—1/16 in. to ⅛ in. long—is a necessity.

In welding nickel to steel the usual and preferred metallic arc electrode is the No. 130X Monel metallic arc welding rod. Satisfactory joints can be obtained, however, with the No. 131 (No. 135) nickel metallic arc welding rod. This type of joint is met with in the use of solid nickel fittings, such as nipples, tube ends, and forgings, where the nickel seal weld on the nickel side is reinforced with a weld on the steel side. It is also met with in some designs of evaporator steam chests, in welding the nickel tube sheet to the steel shell of the steam chest.

(This article will be continued in the January, 1939 issue.)

Rectangular shaped wind tunnel fabricated by arc welding plates from ⅜ to 1 in. thickness.

» «

M. I. T. Dedicates New Welded Wind Tunnel

★ Progressive improvement in welding methods and materials, and the important position which welding has achieved in the industrial picture during recent years, are once again spotlighted by the completion of the first welded steel high-pressure wind tunnel of its type to be built in the United States. The tunnel will permit the testing of scale airplane models under simulated conditions such as would be encountered in the substratosphere, and also at flying speeds as high as 400 miles per hour. Since no existing tunnels available for commercial testing are able to create such conditions, and the need was realized, the Massachusetts Institute of Technology Corp. authorized the staff of the Guggenheim Aeronautical Laboratory, headed by J. C. Hansacker, to proceed with the erection of such a tunnel. Work was done under the supervision of Dr. H. Peters, assistant professor of Aeronautical Engineering. Contract for the structural design, fabrication, and erection of the unit was awarded the Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa., and work was begun in October, 1937.

The new tunnel is of electric-arc welded steel plate construction, plates varying from ⅜ to 1 in. in thickness, and consists of conical and cylindrical tubes arranged to form a rectangle measuring 44 ft. x 89 ft., and to make a closed circuit 196 ft., 2 in. in length along the center line. Inside diameter varies up to 19 ft., 4 in. maximum. The steel plates were formed at the Neville Island, Pa., plant of the contractor, and the edges prepared for the butt-welded joints either by planing or by machine flame cutting. Welded units were built-up for shipping, and final assemblies made at the site to form the complete tunnel. The tunnel was built in accordance with the American Society of Mechanical Engineer's Unfired Pressure Vessel Section of the Boiler Code. It is estimated that more than three miles of welding rod were used in assembly.

Upon completion, the structure was subjected to an hydrostatic test to a gauge pressure of 54 psi. without the development of a leak in any of the welded seams or joints, nor was there any indication of weld failure or weakness. This test also served partially to stress relieve the tunnel, since the test pressure was 25% in excess of the intended working pressure. This excess pressure, by pre-stressing the metal at the points where shrinkage or secondary stresses are close to the elastic limit of the metal, serves to insure adequate fatigue endurance.

The tunnel, which has been named the "Wright Brothers Wind Tunnel," was formally inaugurated with ceremonies attended by prominent aeronautical engineers. The unit represents a progressive addition to aviation's experimental facilities, and, in keeping with the constantly increasing size and speed of modern aircraft, is designed to permit the simulation of flying conditions in the substratosphere and to provide effective air stream speeds beyond the capacity of existing wind tunnels now available for commercial testing.

Air is forced around the tunnel by a 12 ft. 11¾ in. diameter propeller driven by a 2000 hp. ac. motor having four speeds from 450 to 1200 r.p.m. The air stream is turned around the corners by means of welded crescent shaped vanes so designed that the air flow direction is changed efficiently and in such a manner that a uniform cross section of air velocity is maintained.

Welded crescent shaped vanes are employed to turn the high-velocity air stream around a corner in the tunnel.

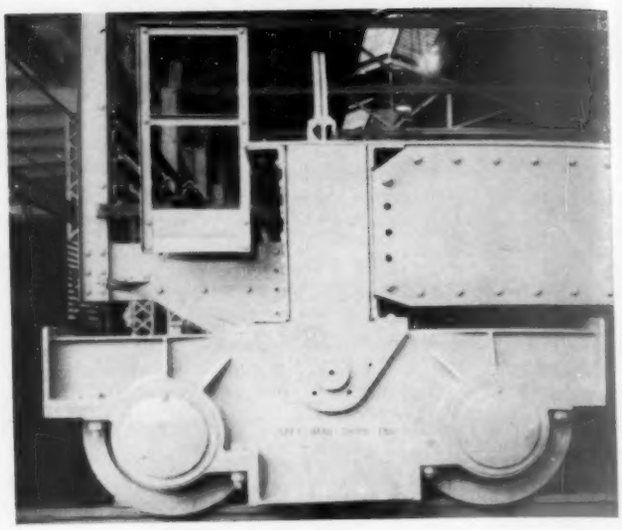


Fig. 35—Welded end truck for a Whiting 50-ton hot metal crane.

Flame-cut shapes and arc welding are

Cutting Fabrication Costs

★ Part 3—Additional convincing evidence of weight savings — Reduction in "dead weight" cuts operating costs of cranes — Earth moving equipment built entirely by welding

Whiting Corp. Uses Welded Assemblies for Cranes

★ Since 1928, Whiting "Tiger" cranes have used welded steel trolley frames and welded steel end trucks. Main cross girders are riveted, principally because there is still a pronounced resistance to all-welded cranes in the minds of some buyers. When this resistance wears away, most of the crane builders will very likely revamp their designs to use welded girders.

Each Whiting crane is "engineered for the job." The end truck is built up of steel sections welded together as shown in Fig. 35. This illustrates a ball-bearing type of equalizing "bogie" truck for a 50-ton hot metal crane.

Welded steel trolley frames combine strength with minimum weight. In the Tiger mill type crane trolley frame shown in Fig. 36, the structural members composing the frame are securely welded together, forming a rigid one-piece assembly of maximum strength. Whiting claims that this type of construction results in a substantial weight saving. This weight saving is important in the operating cost of the crane, because every pound saved means that much less dead weight has to be moved every time a load is carried across the bridge.

Welding is also used by Whiting in building huge hoisting blocks, such as the 60-ton mill type block shown in Fig. 37. The flame-cut edges on the steel plates are clearly in evidence. The hook is a forging. A completely-enclosed construction is used in the interest of safety and to keep dirt from working into the anti-friction bearings.

How flame-cut parts made from rolled steel plate may replace forgings is illustrated in Fig. 38. This shows machine parts cut from 2½-in. steel plate in the Whiting plant.

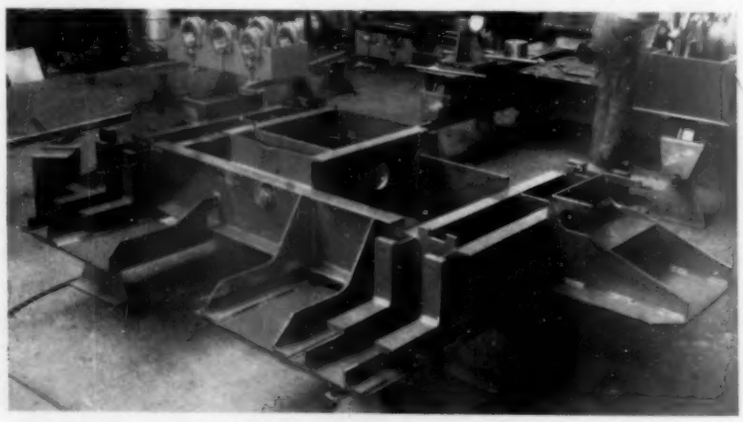


Fig. 36—Tiger mill type crane trolley frame made by Whiting is a good example of welded fabrication.

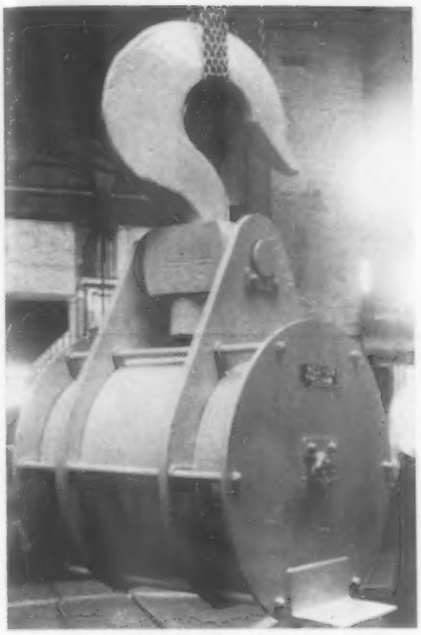


Fig. 37—Welded 60-ton mill type hoisting block—The hook is a forging.

R. G. LeTourneau Inc., Welds Earth-Moving Equipment

★ The photographs, Fig. 39 to Fig. 43, were taken in the plant of R. G. LeTourneau, Inc., Peoria, Ill., said to be the world's largest manufacturer of tractor-drawn earth-moving equipment. In this plant arc welding is the one and only method of manufacture.

The belief of R. G. LeTourneau, Inc. in arc welded steel construction is best illustrated by a recent statement of R. G. LeTourneau, president: "For the past seven years, I have not used a casting or a rivet in my manufacturing process, although in the last year we have produced well over 25,000 tons of finished product."

Figure 39 illustrates the Peoria plant's assembly line where steel is fused together in the manufacture of carryalls.

Figure 40 shows a close-up of a carryall and illustrates the box beams in the framework. These box beams, used as strength members in practically all LeTourneau products, are fabricated of angles and channels by arc welding.

Figure 41, taken in a storage yard, shows several miscellaneous arc welded steel parts of LeTourneau equipment.

Figure 42 demonstrates how the cable sheaves are attached to the yoke of a scraper. This illustrates a design practice of LeTourneau through which remarkable rigidity and strength are achieved with light weight. Welded joints, subject to severe strain in service, are reinforced by bars and straps as shown in the photograph.

Figure 43 depicts an operator arc welding the housing for a scraper unit.

Fig. 38—Machine parts flame cut from 2½-in. steel plate to replace forgings.

Swenson Evaporators and Rotary Drum Vacuum Filters

★ "From the original idea to the finished installation" is the slogan of the engineers of Swenson Evaporator Co., Harvey, Ill. This organization has the experience and facilities needed in the development of new methods and equipment, involving evaporation, crystallization, and filtration problems. In designing equipment for the process industries, it is necessary to study the characteristics of the liquid to be handled, the plant operating conditions, and previous experience in the same or allied industries.

Material of which evaporators are fabricated is an important factor in maintenance and operating cost. Swenson has built evaporators of welded steel, cast-iron, cast lead, cast aluminum, cast bronze, nickel, nickel-clad steel, 18-8 stainless steel, 18-8 stainless-clad steel, copper, and Everdur. In the Swenson plant at Harvey, Ill., the fabricating and structural shop includes rolling, punching, cutting and welding machinery, as well as assembly floors for erection and testing. Figures 44-47 inclusive show Swenson evaporators and rotary drum filters in various stages of construction.

The high physical properties of arc welded joint in the plates of vessels designed for the process industries has exerted a prominent influence on their design. Welding has made possible better designs of lighter weight, and with equal, if not greater safety. Welding permits a wider choice of materials, ease of fabrication and greater

Fig. 44—Huge evaporator tank mounted on rollers and tilted by crane to facilitate welding.

Fig. 45—Heating element for a black liquor evaporator.

freedom of design, as well as size of structure. The increase in use of welding has had an indirect effect on the production of quality steels.

The steel companies have produced welding steels of such excellent physical properties, that it is only fair to credit both the present day steels and welding in the development of better pressure vessels and process equipment. Welding has made it possible to utilize various alloys which will withstand corrosive action, thereby increasing the life of such equipment, in some cases indefinitely. Ordinary car-

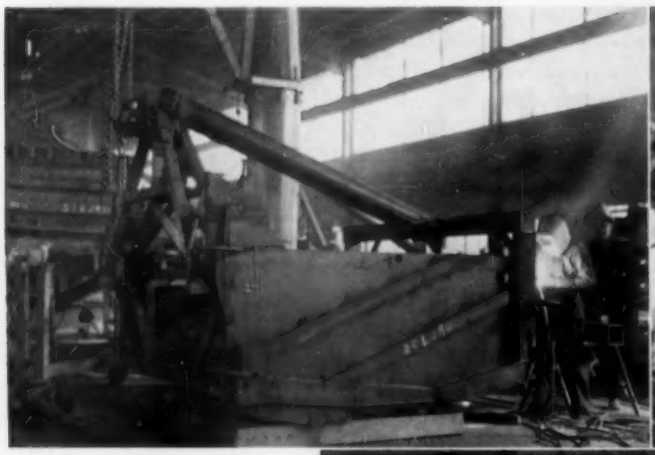


Fig. 39 — Welding assembly line in manufacture of carryalls.

Fig. 40 — Close-up of carryall showing box beams made of angles and channels welded together.

Fig. 41—Miscellaneous welded steel parts in Le Tourneau storage yard.

Fig. 42—Attachment of cable sheaves to yoke of scraper.

Fig. 43—Operator arc welding housing for scraper unit.

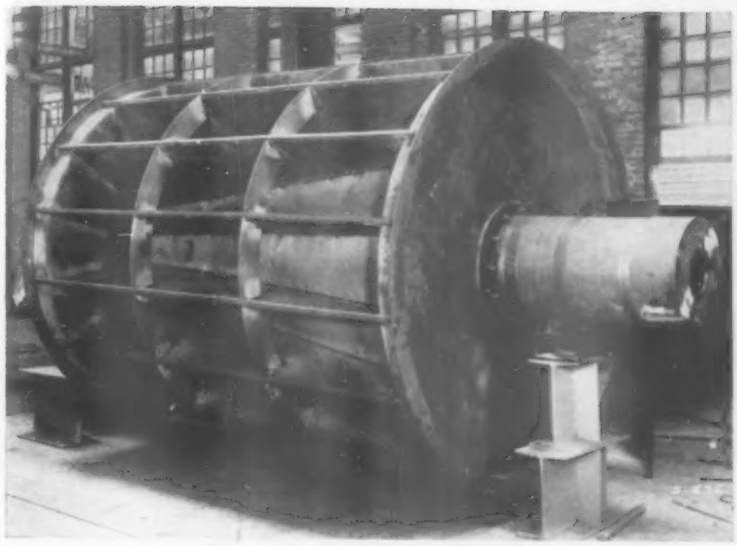


Fig. 46 (Top)—Rotary vacuum filter drum, partially assembled—Photo, courtesy of Swenson Evaporator Co., Harvey, Ill.

Fig. 47 (Bottom)—General view of erection shop, showing evaporator work in progress—Photo, courtesy of Swenson Evaporator Co., Harvey, Ill.

bon steel corrodes very fast when used for applications in the chemical and oil industries. Where clad material is used, welding plays an important part in building the equipment.

» «

New Welding School at Westinghouse

★ Complete with the most modern equipment for d-c., a-c. and automatic welding, the new welding school in the East Pittsburgh plant of the Westinghouse Electric & Mfg. Co. is designed to give thorough training to each student and inform him on the latest practices in arc welding. The students' training begins with bare wire in order to emphasize fundamentals of good fusion and proper penetration, and develop skill in welding. After the student has received sufficient instruction with bare wire, training starts with coated wire.

Believing that the development of skill in manipulation of the arc is essential, each student is assigned an individual machine, which he uses throughout the course. Two instructors are on duty at all times to assure that each student has ample individual instruction and guidance. The complete course consists of 200 hrs. The average work week is 40 hrs. so that, except for holidays interfering, the course is concluded in five weeks.

This air-operated press is used to test student's welds to show reason for imperfect welds.

» «

THE BELL OIL & GAS CO. has started construction of 11 miles of 4-in. welded gasoline line from its refinery at Grandfield, in Tillman County, Okla., across the Red River to Wichita County, in North Texas. This will be the first interstate gasoline line in the northern part of Texas.

» «

SOUTHERN CALIFORNIA GAS CO. recently completed construction of a welded pipeline extension about 11 miles in length from its system in San Joaquin valley to the towns of Ivanhoe and Woodlake. Some 20,000 ft. of welded lateral and service lines were also laid.

» «

THE RENO STEEL & METALS CORP., Glendale, Calif., will begin work immediately on the construction of a welded steel storage building at 2219 Barranca St., Los Angeles, for the W. P. Fuller Co.

Each student has a booth and machine assigned to him for individual use.

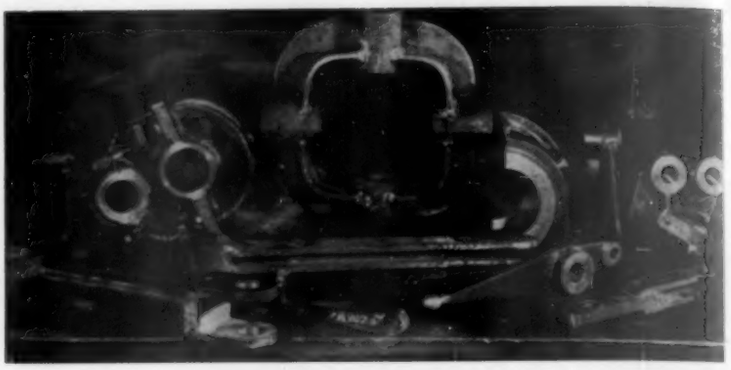


Fig. 6—Welding will increase at least 50% when engineers learn the potential savings possible in fabrication of small welded parts.

Helpful pointers which will aid the success of

A Commercial Weldery

★ Part 2—Digest of paper winning first prize in recent Lincoln Award Program—Large savings possible by changing small parts from castings to weldments

By A. E. GIBSON and M. W. GIBSON
President and stockholder, respectively, Wellman Engineering Co., Cleveland, Ohio

SINCE THE AVERAGE weldery has been developed as an addition to a previously organized metal fabricating company, a complete analysis of capital equipment will not be attempted. Also there are many successfully operated welderies which purchase steel cut to order, or carry stock sizes which are prepared for use by gas cutting. It is possible to carry on extensive welding operations without saws, shears, tables, floor plates, or other auxiliaries. The total capital investment is dependent upon the scope of work to be attempted and the capacity of the plant.

ENGINEERING AND DESIGN.—In the organization of a commercial weldery, the next step is by far the most difficult, and upon it depends the success of welded fabrication. It is absolutely essential that competent designers and detailers be obtained. It is only through having the courage to depart from past experience and training that welded design can succeed. The writer has experienced instances in his company where attempts to redesign cast details for welding have failed nine times, but the tenth try resulted in a design highly successful, both from the standpoints of efficient operation and reduction in cost. The promises of revolutionary design in castings is remote, but with welding, the opportunities are unlimited. All that is needed to insure success is inspiration, imagination, creative thinking, and the will to pioneer.

Many engineering companies overlook the large savings made possible by changing over small mechanical details from castings to welded construction. Too often these details are given scant consideration, because of the small amount of money involved in each item, and attention is centered almost entirely on large pieces. During the course of a year we produce thousands of small miscellaneous details in welding, and the cumulative saving is large. Figure 6 shows a few small pieces of details generally made of cast steel which we regularly make by welding. The tendency is simply to use the cast design drawing and change the construction to welding. This is almost always a mistake from a cost standpoint. Thought must be given to labor reduction through the use of rolled sections, and to straight line construction, which permits low cost in the preparation of the material for welding and of still greater importance, elimination of welding labor.

The three-piece gear reduction case, shown in Fig. 6 (left) is an interesting example of the comparative costs of cast and welded small parts, because it would appear that such pieces would require so much labor to prepare the metal and to weld that they would not be cheaper than castings. Table 1 gives a cost comparison of the two methods.

Figure 7 shows a cast and a welded corner bracket produced in lots of 50 or more at a time. Without considering the cost of the pattern, the saving of the welded part over the cast design is 21%. This saving resulted from the use of a rolled angle and a

This is final installment of brief of the Gibsons' paper which won the grand award of $13,941.33. First part of this brief was published in the November, 1938 issue, pages 24-27.

Table 1—Comparison of Cast and Welded Costs—Gear Reduction Case

Steel Castings:			
Four sets of 3 pieces—388#			$63.48
Pattern			
32 Hrs.	@	$1.75	56.00
47 Ft. Lumber	@	.10 ft.	4.70
Total Cost of Castings			$124.18
Welded:			
Material	355# @	$ .03	$10.65
Struc. Hrs.	17 @	1.45	24.65
Weld Hrs.	18 @	2.25	40.50
Burn Hrs.	11 @	2.25	24.75
Total Welded Cost			$100.55
Saving in favor of welding			$23.63
% Saving			19%

plate with punched holes, which was bent to the required shape. The welding was thus reduced to a minimum with the parts assembled in a fixture. The comparative shop costs of the cast and welded brackets are as follows:

Steel Casting 41# (no pattern cost)			$5.95
Welded:			
Shear	3.5 min.	$ .084	
Punch	1.4 "	.034	
Bend	4.0 "	.133	
Fitting	8.9 "	.214	
Gas Cut	11.0 "	2.745	
Weld	62.2 "		
Grind	7.4 "	.178	
		3.388	
Material		1.320	
Total Welded Cost			$4.71
Savings in favor of welded design			$1.24
% Saving			21%

In fabricating plants thousands of such parts can be found which lend themselves to welding with equally attractive savings. Only lack of inspiration and thought on design prevents their transformation into the more economical welded construction.

The evolution of the counterweight sheave block shown in Fig. 8 is an interesting story in design. The one at the top of the photograph is a steel casting. It was originally made of cast iron, but high stresses and rough usage soon ended its career in that material. Our vigilance to cut cost corners sent the detail back to the engineering department for redesign in welding. The block in the center of the picture was the result, although there was no saving effected, except the absorption of shop burden.

A more recent attempt at cost reduction, instigated by the welding shop, brought forth the detail shown at the bottom. The comparison of cost is enlightening. (See Table 2.)

An additional saving in the latest design is elimination of facing of the four bosses in machining. Comparing the two welded units, it will be seen that the bosses around the bored holes have been eliminated. This reduces the welding by six feet, and does away with the cost of the washers. The profile of the ends has been changed, simplifying the gas cutting, and reducing the material cost. In place of two heavy side plates in the first welded block, a light gauge bent plate has been used to provide the oil pocket for the shafts—a further saving both in weight and labor.

One of the functions of an engineering department is to specify exactly the size and shape of every weld to be made. It is not the duty of a welding foreman or operator to guess the stress to be applied to any weldment. Therefore, a suitable method of designating welds should be adopted and used on every drawing sent to the shop for fabrication. Our company has adopted the A.W.S. standard welding symbols. Copies of these are given to every draftsman and to the shop. Guess-work is eliminated, and each weld is made in accordance with the calculated weld strengths determined by our engineers.

RESEARCH AND INVESTIGATION.—With the advent of the new low-alloy, high-strength steels and their advantages of high tensile strength, high elastic ratio, and resistance to abrasion or corrosion, the problems of design and welding fabrication become complex. For years, we had been disheartened by the costly failures of certain castings in clam shell buckets when these were subjected to severe tensile, bending and impact stresses. The constant increase of metal sections where failures occurred did not eliminate the breakage. The designs were such that in the castings, planes of heavy metal were joined at right angles to lighter sections with heavy fillets at the angle.

All the hazards of foundry practice were encountered in making these castings. The use of large dry sand cores prevented natural shrinkage of the cooling metal. Cracks developed in cooling. Shrinkage occurred, causing cavities which were hidden by the outer crust of metal. Segregations produced sections far weaker than the analysis of the heat would indicate. The result was failure in service, complaint from the customer, expense of replacement, and, of far more serious import to a manufacturer, a "black eye," making future sales to the customer extremely difficult.

Table 2—Comparison of Cast and Welded Costs—Counterweight Sheave Block

Cast Steel			
(Pattern development not included)	12.60#		$89.05
First Welded Design	530#	$72.36	
C. I. Counterweight	425#	19.00	
	955#		91.36
Second Welded Design	525#	$55.59	
C. I. Counterweight	350#	17.40	
	875#		$72.99

We were welders, we had a creditable array of imposing low carbon weldments to point to, and now we could obtain a new steel possessing 60,000 psi. yield, 90,000 psi. ultimate strength and over 20% elongation in two inches. If we could redesign the faulty parts, build them by welding, using this steel, we felt certain the breakage would be overcome.

Our experience was so encouraging that we carried on an investigation of all the new low-alloy steels as they were brought out. As we became familiar with the technique of shaping, welding and heat treating of low-alloy steels, and as our engineers, striving to increase the strength of equipment and reduce its weight, learned the short cuts in fabrication cost, a wide and varied array of structures became an inviting field for welded high strength steel.

A striking example of the advantage of the use of low-alloy steels is found in a recent proposal to an eastern rail-

road desiring coal loading equipment. The customer advised us that although our design was acceptable, the weight of three machines, built of low carbon steel, was too great to permit their use on the existing pier which had been designed to carry lighter equipment. Our knowledge of the use of high-strength steels, coupled with welded mechanical equipment, permitted a design incorporating a chromium, phosphorous, copper steel in heavy rolled sections, resulting in a weight reduction of 20%.

COST RECORDS.—The business wrecks strewing the road of America's industrial progress are more the fault of lack of knowledge of costs than any other single cause. Among medium and small sized industries, the greater number still adhere to an antiquated method of estimating costs, by lumping all operations into one price group, and by keeping actual cost records, if they are kept at all, in the same manner. For instance, all labor, layout, shearing, gas cutting, bending, fitting-up, welding, cleaning and machining carry the same labor and burden rate. The fallacy of this procedure should be evident to anyone who gives any consideration to the actual expense connected with these various operations.

Fig. 8—Design evolution of a sheave bracket. In center is the first welded design (not profitable). At bottom is latest design which cut cost of cast steel 18%.

Fig. 7—Welded design of a small part eliminated service failures. Also cut cost 21%.

A layer-out, a fitter, a cleaner, work without the aid of power-operated tools. Bending, gas cutting, welding, and machining operations are performed with equipment costing from a few hundred to many thousands of dollars. Some operations call for operators, who because of their high degree of skill, command high rates. Other operations can be performed by unskilled or semi-skilled men. Depreciation of equipment, taxes, floor space, power consumption, lubrication, small tools, supplies, and many other incidental costs must be paid for. These go to make up legitimate charges which should be borne by the particular operation requiring them. To prorate these costs over all operations means that certain operations are sold at too low a cost, others too high.

As an example, we purchased last year a plate bending brake, costing $8,500. Dies and special equipment for it cost an additional $600. An electrically operated jib crane, at a cost of $500 was installed to service this tool. Valuable floor space, 20 ft. x 20 ft. was taken up, and the electric power to operate a 25 hp. motor is consumed. Our estimate of the actual cost of operating this tool, the labor and shop burden, is $2.00 per hour.

Now, let us take another classification of labor, the fitting of parts for welding. No machine tools are required, with the exception of an occasional heavy lift with a crane. The fitter works with a rule, a square, and a level, setting the component parts properly and clamping them together preparatory to tack welding. True, the fitter is a skilled mechanic, paid possibly ten cents an hour more than the brake operator, but he uses no costly equipment, little or no power, and much less floor space. Our analysis shows this operation costs in labor and burden $1.35 per hour. The average labor and burden rate for the entire department may be $1.60 per hour.

Now, let us assume that we have to figure a particular job on which the bending and fitting operations take an equal amount of time, say two hours. Two hours bending and two hours fitting at $1.60 per hour is $6.40. The actual cost of these same hours is $6.70. The administration charge of 17½% of the labor and burden rate is $1.12 in one instance and $1.17 in the other. The total cost is therefore $7.52, using an average labor and burden, and $7.87 using the true labor and burden, a difference of 35 cents, or an actual loss with the average burden of 4.6%. This would reduce by nearly 50% the profit normally figured, and in times of keen competition, would completely eliminate the profit. The seriousness of this situation is that the company actually believes the job is profitable, and it is only when the profit and loss statement is made—and with many small companies this occurs only at the end of the fiscal year—that the management finds the supposed profits do not exist.

Furthermore, in periods of keen competition, the flat rate basis of estimating often results in loss of orders which would be obtained if correctly figured. Our company has established labor and burden rates covering all operations.

Once a month the Accounting Department tabulates an actual burden cost for each department. The expense is broken up into many classifications, and the burden sheet carries the comparison with the previous month and the total for the year to date. The works management has before it complete information on burden costs. If the cost of any one item for any one

month is high, a comparison with costs for previous months quickly shows the reason, and steps for correction can be taken. Information on any particular detail of the burden is readily available to a shop department head. A typical burden sheet is shown in Fig. 9.

Use Original Cost Estimate

Little work is obtained today without firm quotations. Therefore, when an order is received, the estimate upon which the work was priced is available. When the work order is sent to the shop, a data sheet accompanies it, listing the material required and the labor hours originally estimated. Without this information, particularly the labor estimate, the shop would work completely in the dark. Every foreman should have the labor estimate available and be held accountable for producing the work within the hours figured. Daily records of consumed hours should be kept and be available so that the shop management may know at all times by comparison of the consumed hours with the estimate, just how the work is progressing.

Some such method of labor control is essential for efficient management. In our company the detail record-keeping is not duplicated in the shop and office. The cost accounting department is not concerned with keeping a record of the labor details entering into the costs. Only summaries are kept in the office for compiling total costs. If detailed information concerning any operation is desired, it may be obtained from the shop office. Our shop labor records are kept by one individual for the structural and welding shop, which normally employs about 100 men. The expense of record-keeping is small and unimportant in comparison with the results obtained by holding the shop management responsible for results.

PUBLICITY AND SALES PROMOTION.—Our employees who contact the trade are engineers. They are familiar with our production facilities and are welding-minded. This has prompted them to suggest to customers that better, stronger, and cheaper details may be made by substituting welded parts for those designed as castings. In many instances these sales engineers either make free-hand sketches during their calls, or bring the customer's drawings to our drafting room for redesign in welding before submitting prices on the work.

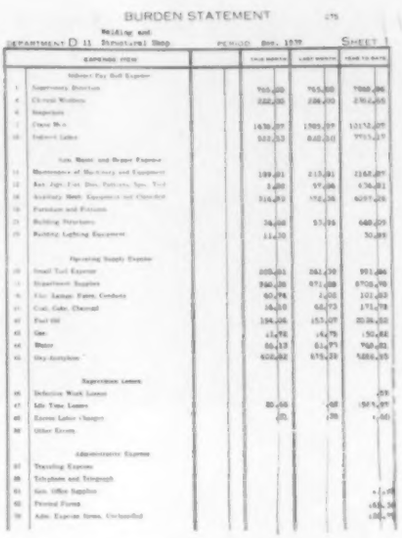

BURDEN STATEMENT

Fig. 9—Monthly burden sheets are helpful in keeping expenses in line.

In addition to personal contacts of our sales engineers, we advertise in trade magazines, by letters, a twelve-page yearly calendar, and monthly blotters broadcast to the trade showing our achievements in engineering and production. We furnish copy and photographs of welding equipment for national advertising by steel companies, and to manufacturers of welding equipment and supplies.

CONCLUSION.—One cannot review the industrial progress of the past few years without realizing that no factor has contributed more to that progress than welding. Our national wealth has grown as our industrial developments have made possible lower costs and a wider distribution of commodities. American incentive, ingenuity, and ceaseless effort have in the past borne fruit. Mechanized farming, mechanized industry, mechanized distribution are the only means of creating greater wealth.

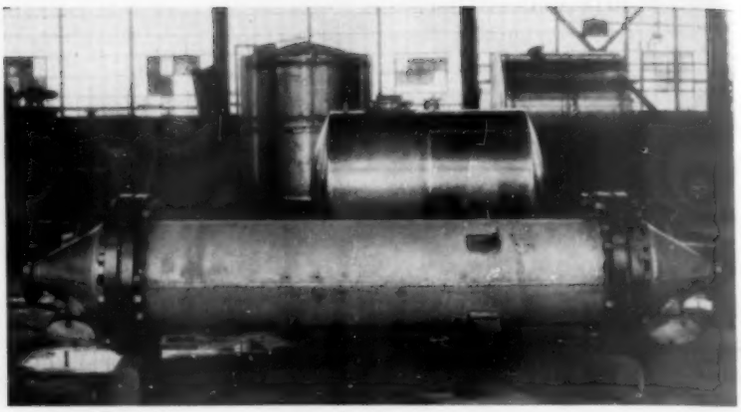
What part will welding play in this program? The answer to that question can be found by looking at the record of the recent past. Today, our unmatched distribution of automobiles is the envy of the world. Without welding, the modern automobile could not be made. Our distribution of household labor-saving appliances is unparalleled. Estimate the cost of an electric refrigerator built without the welding art. In transportation, the electric locomotive, the light weight diesel engine, the high speed train, and the modern ship have been made possible through welding. Increasingly, our bulk handling machinery, our bridges, our machine tools, our buildings, and furniture, have been built with the aid of welding. This progress has resulted only because through welding can this stronger, lighter, more efficient equipment be built at lower cost.

With this background, can any engineer, any industrialist, yes, even any layman question the importance of the welding art in our material progress? This is a challenge to the commercial weldery. Will it accept that challenge?

In this analysis of a commercial weldery, we have endeavored to point out the fundamental principles upon which success is built; management, design, production technique, and research. We have said much about reduction of cost through reduction of labor. That is the basis upon which progress is built. There is every promise of the commercial weldery contributing its full share toward future national prosperity.

» «

Metal spraying a pump cylinder to replace metal worn in service. This process also is used to obtain corrosion resistance.



Welded Herculoy processing unit designed to operate at 300 psi. and 400 deg. F.—Carbon arc welded—Photo, courtesy Leader Iron Works, Inc., Decatur, Ill.

Long carbon arc welding of

Copper and Copper Alloys

★ Carbon dioxide vapor of a long carbon arc (¾ to 1¼ in.) shields the metal effectively—Rapid cooling of weld area inhibits segregation of cuprous oxide

By W. C. SWIFT

Consulting Engineer, Compressed Industrial Gases, Inc., Chicago, Ill.

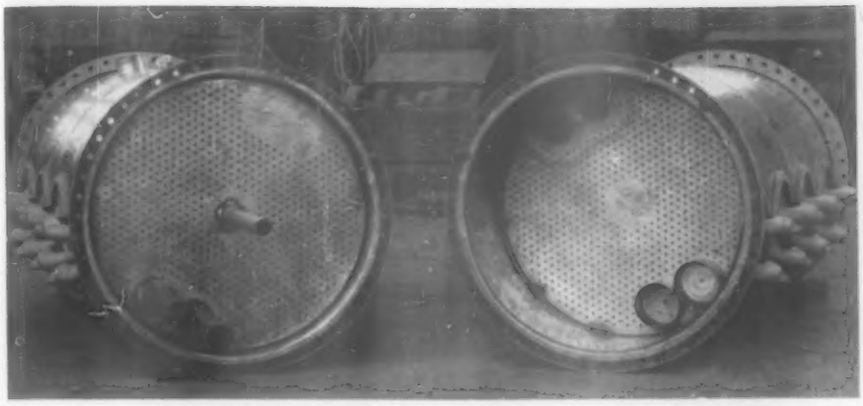
THERE HAS BEEN some confusion in the use of the terms "bronze-welding" and "brazing," because of the rapidly increasing use of bronze for making joints in cast and malleable irons and steel, but the welding industry now seems to have definitely accepted "bronze-welding" to describe any open "V" type joint and "brazing," any joint where the base metals are closely fitted and the brazing metal, either copper or silver or an alloy, is flowed between the proximate surfaces. Bronze-welding as now practised began early in the present century, the development of electric and oxy-acetylene welding moving along together. Each was employed on a large scale during the war, both processes making tremendous strides which have since continued until today welding is our sixth largest industry. No metal is now regarded as of great industrial value unless it is readily weldable, obtaining joints that are both strong and ductile.

Until recently, our oldest metal, copper, the use of which dates back to 5000 B.C., has been found most difficult to weld and secure strong ductile joints because of its high heat conductivity and because the copper in common use contains small quantities of oxygen. These oxygen inclusions, in the form of cuprous oxide, do not affect seriously either its strength or electrical conductivity or resistance to corrosion. But if ordinary copper is held for a few seconds at a temperature about 300 deg. F. under its melting point (1981 F.), the cuprous oxide will segregate within the grain boundaries; so that, although the strength of annealed ordinary copper runs from 31,000 to 33,000 psi., this copper after being oxy-acetylene welded with the deoxidized or silver bearing copper rods in common use has a strength of only about 15,000 psi. While this can be improved by hammering, on many jobs hammering is not feasible and the work has had to go into use with the low strength left in the copper after welding.

Copper sheet and plate as well as copper rods, however, can be supplied deoxidized for welding and strengths in the weld, and in the copper adjacent to the weld, are then obtained that approximate the strength of annealed ordinary copper. The problem of supplying sufficient heat, however, limits efficient gas welding to the smaller and medium size pieces of sheet and plate, whether of ordinary or deoxidized copper.

Deoxidized Copper

Deoxidized copper is slightly more costly, the sizes of the sheets and plates in which it can be supplied are not large, its heat conductivity is quite as troublesome when being welded as that of ordinary copper, and, in working it hardens a little more rapidly than the copper which has not been deoxidized. For these reasons, the use of deoxidized copper has never been great and but very few, if any, of the large users of copper sheet and plate have made much use of it. This, however, as will be later explained, should change and a larger use of deoxidized copper will probably be made in the future.



Two sections of a welded sieve plate distilling column made of copper—Photo. courtesy of Leader Iron Works, Inc., Decatur, Ill.

During the summer of 1932, it became apparent from the planks inserted in the platforms of both of our major political parties, that beer and liquor would soon be legal. This meant that many new breweries and distilleries would have to be built and much repairing would have to be done to the equipment in the old breweries and distilleries. During "prohibition," however, there being little work for coppersmiths, few new ones had been trained and many of the older ones had died. It seemed, therefore, that a great deal of brewing and distilling equipment would also have to be fabricated by the steel tank shops and about the only method of making joints that these shops used was welding. If a metal could not be easily welded, these shops would not use it. Furthermore, during "prohibition," stainless steel and aluminum alloys had been improved, the equipment for an entire brewery in Germany having been made of aluminum, and welding processes perfected for fabricating these and Monel metal. The makers of these metals now advertised that their metals would serve well for brewing and distilling equipment and argued that, although they are more costly per pound than copper, the completed article would cost less, *because their metals could be easily welded.*

It was, therefore, necessary, if copper was to hold its old position as an outstanding metal for brewing and distilling equipment, that a welding process would have to be discovered or developed for copper that would enable it to be joined rapidly and yet leave the joint, and the copper adjacent, ductile and with approximately the full strength of annealed copper.

I, therefore, took pieces of copper sheet and plate in all the commonly used gauges between 0.050 in. and 0.500 in. and supplies of the following welding rods: electrolytic copper, copper deoxidized with phosphorus, copper deoxidized with silicon, tinned copper, Everdur and the Phosphor Bronzes, A, C and D, and with Robert Berkaw of Hobart Brothers, Troy, Ohio, to handle the arc began trying to weld and braze copper in the different thicknesses by the metallic arc process. It was soon observed that even very high currents, at the then usual welding voltages of 18 to 25, did not provide sufficient heat to bring the weld areas to the melting temperatures of any of the welding rods, at which temperatures "welds" will be accomplished, because the high heat conductivity of the base metal carried the heat away from the weld areas so rapidly that not enough was left for welding. This also made it plain that metallic arc welding with basic rods, which, when welding copper or copper-alloys, is done with reverse polarity, could not be used, as the metals on the negative side of the arc receive only about 30% of the heat of the arc as against 70% on the positive side, and no gas is produced to protect the hot copper adjacent to the weld from the oxygen of the air. This proved that for welding copper, higher voltages and the carbon arc process, which uses straight polarity, would have to be used.

Long Carbon Arc

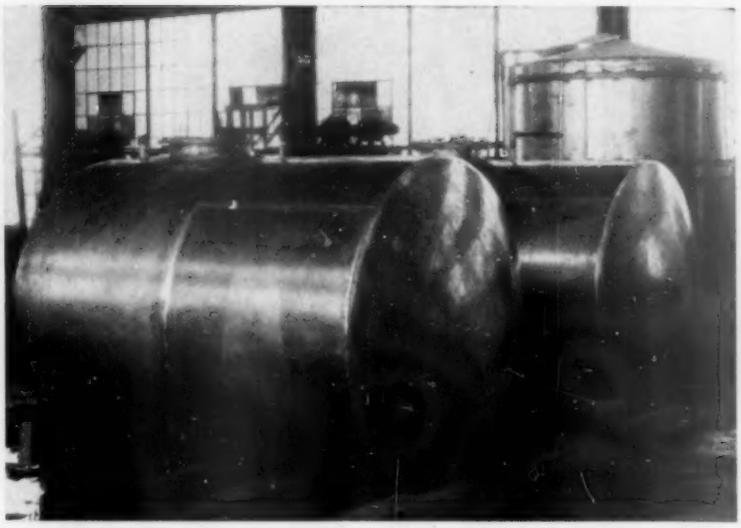
We then made further attempts, increasing the voltages to 40 and higher and using a long carbon arc—¾ to 1¼ in. By so doing, heat was developed and supplied to the weld areas faster than it was conducted away. The weld areas were quickly heated to the temperature at which the Phosphor Bronze "D" rod melted, and the carbon dioxide vapor shielded the hot copper adjacent to the weld from the oxygen of the air. The vapor enveloping a short carbon arc contains considerable carbon monoxide, which is absorbable in hot copper, but the vapor enveloping a long carbon arc is, through its greater exposure to the air, oxidized to carbon dioxide, which is not absorbable by hot copper.

Welding with high voltages and using straight polarity enabled the work to proceed rapidly, while the high heat conductivity of the copper enabled the weld areas to cool rapidly, so that they were not hot enough for a sufficient period of time to allow

Welded steam still made of Everdur—8 ft. diameter, 18 ft. long—Photo. courtesy of Leader Iron Works, Inc., Decatur, Ill.

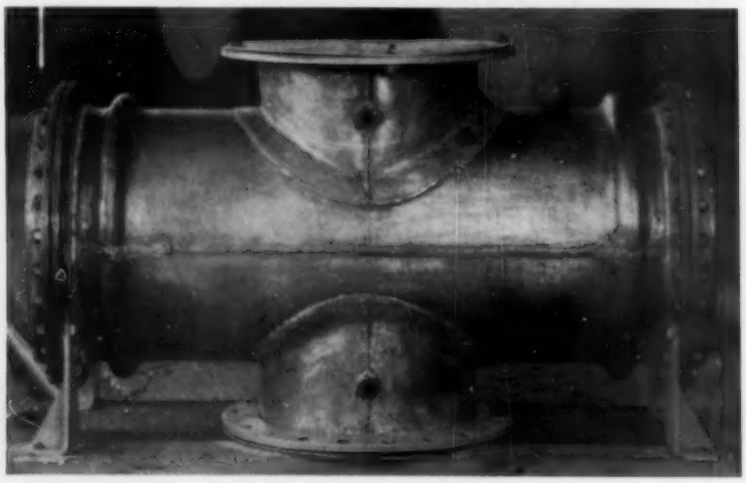
segregation of the cuprous oxide within the grain boundaries. Hence the copper next to the welds retained practically the full strength of ordinary annealed copper.

This rapid rate of welding, essential to good strength when joining ordinary copper, is not practicable unless the right welding rod is used. When welding copper with either ordinary or deoxidized or tinned copper rod, it is necessary to heat the weld areas to complete fusion, since the melting temperatures of these rods and of the copper being welded are the same. Because of the very high heat conductivity of copper, it is most difficult to develop and supply so great a heat to the weld areas and it takes longer to do so, which of course facilitates segregation of the cuprous oxide. Everdur Herculoy, Olympic and Duronze alloys of copper 96%, silicon 3% and 1% manganese or tin or zinc or iron 1%, because they melt 115 deg. F. under copper, worked well on thin copper only; but the Phosphor Bronze D rod, which is high in both tin and phosphorus, worked perfectly by the "long carbon arc welding process" on all thicknesses of copper from 3/64 in. to ¾ in. The Phosphor Bronze D rod melts at 150 deg. under the melting point of copper, which is also most helpful when it comes to the matter of producing and supplying the requisite welding heat, especially for copper plates of a substantial thickness. But an equally important thing is that Phosphor Bronze D is the only weld metal we found which did not break down under the intense heat of the long arc needed to raise the temperature of the weld areas of the heavier copper to that of the melting temperature of the rod. We ascribe this largely to the high tin content of this rod, because while tin melts at 450 deg. F., it does not boil until heated to 4100 deg. F.



Welded copper pressure tanks (75 lbs.) for a beverage plant—Photo, courtesy of Leader Iron Works, Inc., Decatur, Ill.

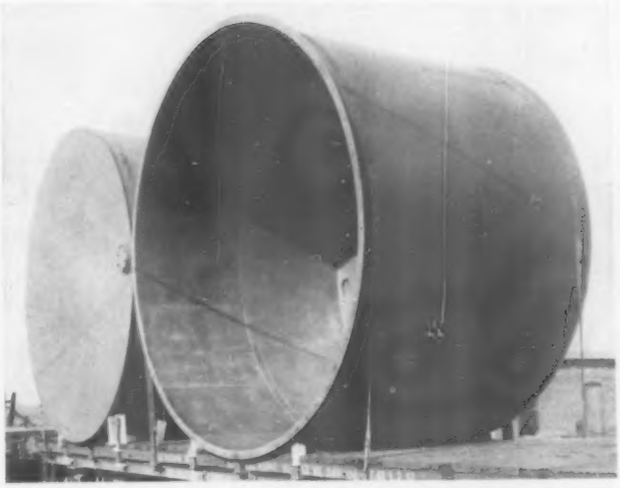
We, therefore, secure by this process of welding the conditions essential to producing strong, ductile welds in copper, which are: a quick, sufficiently intense heat, a protective envelope of non-absorbable gas and a weld metal which is not injured as it conducts the heat to the weld areas of the copper being joined. These joints, when correctly made, and the copper adjacent, have practically the full strength of annealed copper, can be bent and folded together without cracking, and are made at the rate of 10 to 40 in. a min., depending on the thickness of the copper being welded and the voltage and current employed.



Welded copper condenser used in fatty acid distillation—Photo, courtesy of Leader Iron Works, Inc., Decatur, Ill.

Prior to this development, joints in copper sheet and plate were made by lock seaming and soldering, by riveting and soldering, by brazing with spelter solder (50% copper and 50% zinc), by oxy-acetylene welding with high-zinc welding rods or welding with electrolytic or deoxidized or silver bearing copper rods, bare or tinned, methods which are very slow and anneal and oxidize the copper over wide areas, favor intercrystalline segregation of oxides, and generally call for a great deal of subsequent pickling, hammering and straightening. Spelter-brazed joints are also generally made with staggered lines, with the edges scarfed by hammering, requiring much work preliminary and subsequent to brazing. When "long carbon arc welding" copper, there is no preparatory work necessary, other than cleaning and beveling the edges of plate 3/16 in. and thicker. The copper ½ to 1 in. away from the weld, immediately after welding, is cool, but of course warms up quickly momentarily as the heat flows from the joint. There is, therefore, little, if any warping, even on long seams. The weld metal contains but 10½% of tin, with resistance to corrosion equal to or better than that of copper, as against 40 to 50% of zinc in the gas welded bronze or spelter brazed joints, objectionable for some work. When conditions of use require, the weld can be made using a short arc with Everdur Herculoy, Olympic or Duronze rods on copper that is not too thick.

Not only can copper be welded to copper and to steel by the "long carbon



Everdur lined welded steel tanks (13 ft. dia.) — Photo, courtesy of Leader Iron Works, Inc., Decatur, Ill.

arc" process, but brass can be welded to brass and bronze can be welded to bronze, also to one another or to copper or to steel, obtaining joints that are both strong and ductile. This is most useful when coating friction surfaces or building up worn bearings or attaching copper and copper-alloy equipment to steel supporting frames. These deposits, when made directly on cast iron, are liable to be productive of occasional hard spots, but if the iron has been previously coated with a yellow bronze by the oxy-acetylene process, the Phosphor Bronze D can then be deposited on the yellow bronze by the long carbon arc using a burnt borax flux without forming cementite.

Heavy Current Needed

Little can be done "long arc welding" copper with the old 18 to 25-volt arc welding generators worked singly. In such case, two or three of these generators should be worked in parallel. If a shop is getting new welding equipment for copper fabrication, we would suggest considering 300 or 400 amp. (or larger) 40-volt machines. To get good joints, the copper sheet or plate to be welded should be free from oil or grease, not only on the weld areas, but for a considerable distance back on each side. Thin edges to be welded must be backed, preferably with a copper bar having a shallow groove 1/32 in. x ⅛ in. thick and under should be separated the thickness of the material. Thicker copper should be beveled to give a 120 deg. vee and the edges separated 1/16 in. The electrodes should be pointed and held about 2½ to 3 in. from the joint. The Phosphor Bronze welding rod used (it must be high in phosphorus) should be of a diameter such that 1 in. of rod will make 1 in. of weld and the rod should be held almost parallel with the joint. The arc should be struck from the end of the rod resting on the seam and played only on the pool of molten metal at the end of the rod. The welder should at no time forget to hold a long arc, ¾ to 1¼ in., or to weld rapidly—at least 10 in. a min. Less skill and care and a slower speed can be used when welding deoxidized copper, nevertheless, it is better for the welder to make use of all his skill and to be most careful even when welding deoxidized copper, because in "long arc welding" he is handling a most intense heat.

Fabricators whose welders have had little experience arc welding copper should give consideration to the greater use of deoxidized copper, as welding results are more uniform than with ordinary copper and the slightly higher costs per pound can probably be offset by the use of narrower sheets and plates commanding lower extras. An additional seam or two welded by the long carbon arc now increases the cost of the finished article but very little when it can be done so quickly. The strengths of well made "long arc welds" in ordinary and deoxidized copper will be found to average 30,000 psi. for the former and 31,000 psi. for the latter, with 42% elongation in 2 in. For very high pressure work, we suggest using copper alloyed with 3% silicon and 1% manganese, tin, zinc or iron, this copper being commonly known as "Everdur," "Herculoy," "Olympic" or "Duronze". These alloys are welded with rods of the same analysis, by welding procedures similar to those employed in welding steel, obtaining strengths similar to those of welded mild steel.

The development of the "long carbon arc" welding process for joining copper now enables copper equipment for the brewery, distillery, chemical or other plant to be fabricated rapidly and at low costs, thus re-establishing copper among the corrosion-resistant metals on a basis of easy, inexpensive fabrication. Coppersmiths, who have during the past five years made extensive use of "long carbon arc" welding, state that as much of their product, as involves the use of long seams, is now turned out in one hour as was previously done in a whole day. "Long carbon arc welding" has opened to copper the doors of hundreds of steel sheet and plate shops stretching from the Atlantic to the Pacific with tens of millions of dollars of equipment for fabricating by arc welding. Some of these shops have already "long arc welded" and shipped out many carloads of copper equipment through the use of this new process, whose value to the copper industry in the years to come promises to be inestimable.

Future of Copper

If copper had to continue to be fabricated by the slow and costly old processes to compete with the newer, corrosion-resistant, readily weldable metals, which get lower and lower in cost, the day would surely have come in all equipment fabricating shops, as it already had in many, when copper would have found but an occasional use for the larger equipment. But now that joints in copper sheet and plate can be and are being welded with practically 100% high strength, and as rapidly, if not more rapidly, and at an equal, or lower cost, than in other metals, the place of copper in present and future industry is assured. As this becomes known to engineers and users of corrosion-resistant metals, the use of copper is bound to increase steadily.

» «

THE ARKANSAS-OKLAHOMA GAS CO., of Ft. Smith, Ark., is planning the construction of an 18-mile welded gas pipeline from a point near Vesta, Ark., to properties in the western part of the state. Cost of this project will approximate $100,000.

» «

THE MAYWOOD (CALIF.) GLASS CO. has awarded a contract for the erection of a welded steel frame storage shed, to Pennsylvania Iron & Steel Co. The plant will be erected at 5615 Riverside Drive, Maywood, Calif.

Construction noises were eliminated by welding the steel framework of the Ellis Hospital addition in Schenectady, N. Y.—Photo, courtesy of General Electric Co.

Eighth of a series of practical articles on

Technique of Arc Welding

★ Procedure in making fillet welds overhead—Necessary to maintain short arc and keep molten pool in small area

By ROY OWENS
Welding Instructor, Electro-Motive Corp., La Grange, Ill.

FIGURE 48 SHOWS a single-pass fillet weld made overhead using an oscillating back and forth motion. On the forward stroke from *1* to *2* the arc is carried into the corner and along surface of vertical plate. On the back stroke from *2* to *3* the arc is brought out of the corner and it is necessary to concentrate on bottom of horizontal plate so that the weld will extend out of the corner an equal distance on both surfaces. This type of weld can be made with any size electrode up to and including ¼ in., but a smaller electrode will be found less difficult for the operator to control, preferably a 3/16 in. or 5/32 in. Also, a short arc must be maintained to prevent filler metal from dropping. With a long arc the filler metal will not be carried across the gap and deposited in the crater but will fall down. When the arc is of proper length capillary attraction is set up and the blast of the arc will carry filler metal across the gap and cause it to be deposited on an overhead surface.

The current setting for overhead welding will vary from other positions. From 60 to 70 volts open circuit for 5/32 in. and 3/16 in. electrodes and from 175 to 225 amp. will give best results. The reason for low voltage is that when the gap becomes of excessive length the arc will be broken. Also with a short arc, the arc will be confined to a smaller area which will be very helpful in maintaining a small molten pool. A large molten pool cannot be controlled and in all probability will have a rolled edge along the vertical plate and an undercut on the horizontal plate. In some instances, there may be icicles of metal protruding down. The electrode should be slanted 15 deg. ahead of weld and approximately 30 deg. from vertical plate. Motion shown in Fig. 48 is simple and will not require a lot of effort on the part of the operator to make welds of good quality in minimum time.

Figure 49 is similar to Fig. 48, except that a circular motion is used which will require more skill than the

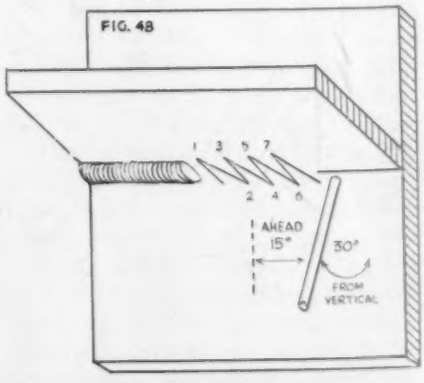


Fig. 48—Oscillating motion used in making single-pass fillet weld in overhead position.

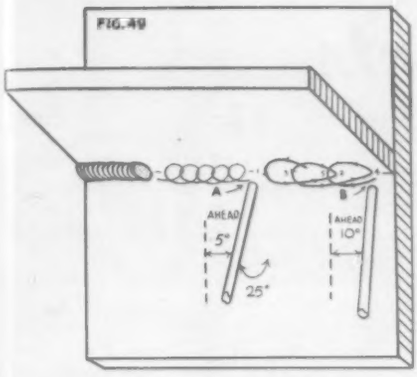


Fig. 49—Overhead fillet weld showing either a circular rod motion or a pear-shaped rod motion (for large fillets).

previous motion and will require a little more time. With this motion a ⅛ in. electrode is used. The electrode should be slanted approximately 5 deg. ahead of weld and about 25 deg. from vertical surface. With this motion less heat will be used due to the fact that more time is spent on the weld. The parent metal will become more heated and require less current to cause fusion. On the forward stroke, as indicated by arrow, the arc is carried into the corner and along the vertical surface to insure penetration and fusion. On the circle back, the electrode is drawn out of the corner and concentrated on the bottom of the horizontal surface. The reason for the circle motion back is to deposit additional filler metal with a single pass.

Motion *B* in Fig. 49 is a pear shaped motion and is used for making large fillet welds overhead. A larger electrode is used (5/32 or 3/16 in.). This motion is recommended for welds up to ⅜ in. width.

The length of the stroke will govern the size of the weld. If a long stroke is used the size of the weld will be increased, and vice-versa with a short stroke. If the stroke is shortened too much, trouble may be encountered due to molten pool becoming overheated and causing molten metal to drip and form icicles of metal. On the stroke from *1* to *2* the arc is carried forward and at *2* the operator should see that good penetration and fusion is being obtained in the bottom of the corner. As the weld proceeds, more filler metal will be added which will bridge across, but will not fuse the smaller part of the corner. From *2* to *3* the arc is carried back roughly parallel to the line of weld and the arc is slightly lengthened to allow heat to be spread over a larger area. From *3* to *4* the arc is shortened gradually. The electrode is carried 10 deg. ahead of weld and approximately 30 deg. from the vertical surface. With this motion, the operator will find some difficulty when ending up welds, without the crater being improperly filled. To avoid this, the arc should be broken at the end of the weld and the crater allowed to cool a few seconds. Then restrike the arc in the crater and add additional metal to fill.

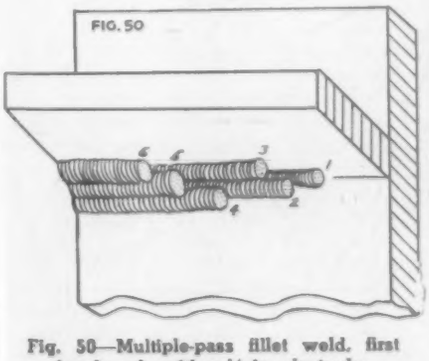


Fig. 50—Multiple-pass fillet weld, first bead made with a ⅛ in. electrode.

Multiple-Pass Fillet

Figure 50 is a fillet weld made with a series of straight beads. The first pass requires a small electrode (⅛ in. with 125 amps. and 75 volts on open circuit). The electrode is carried at a 5 deg. angle from corner and a short arc is maintained. The scale should be completely removed before any more welding is done.

For the second pass a 5/32 electrode should be used and the heat increased accordingly and electrode carried at same angle as first pass. The bead should lap over one-half of the previous bead. Then the third pass is put in with the same size of electrode and heat, but the electrode should be held at almost a vertical position so that the weld will blend into the parent metal. A 3/16 in. electrode is used for the 4th and 5th passes and the electrode is slanted 30 deg. from the vertical surface. For the 6th pass, the electrode is again carried at almost a vertical position.

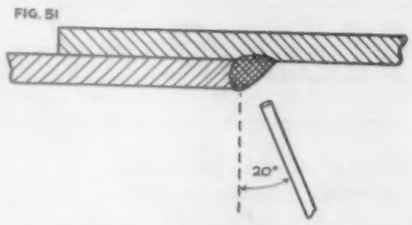


Fig. 51—Electrode position for overhead lap joint. Heat is concentrated on upper plate.

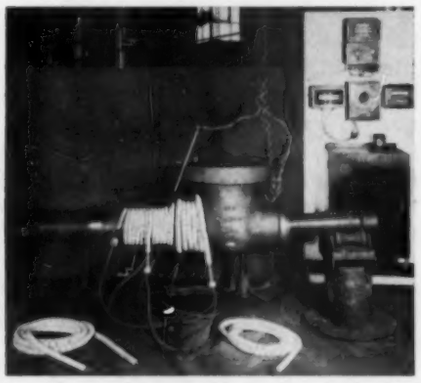
Figure 51 shows a fillet weld on a lap joint. On this type of weld the electrode should be held at about 20 deg. from the vertical line so that most of the heat is concentrated on the upper piece. This will prevent burning away the edge of lower plate, because the heat can only be radiated out in one direction on the lower plate. On the upper plate, the heat can radiate out in both directions. Motions shown in Fig. 48 and Fig. 49 can be used for this type of joint.

A Wiggins pontoon roof on a gasoline storage tank at Kansas City, Kan.—Welded construction enables the complicated parts of the roof to be assembled more easily than if riveted.—Also makes a much neater and cleaner job.—The roof rides on the liquid in the tank.—Space between deck of the roof and shell of tank is closed by means of a seal which forms a sliding contact with the tank shell.—Shell is butt welded so as to have a smooth interior and better contact with the roof.—Photo, courtesy of the Chicago Bridge & Iron Co.

New Product Developments

"Falcon" Coil Type Stress Relieving Heaters for Pipe

★ H. O. Swoboda, Inc., New Brighton, Pa., has introduced the "Falcon" electric stress relieving heaters for welded piping. These are coil-type "wrap around" heaters fitted with insulating bushings over their entire length. "Falcon" heaters are designed for wrapping around pipe joints to develop heat before, during, and subsequent to welding.



Method of applying "Falcon" coil-type wrap-around heaters for stress relieving pipe joints.

These "wrap around" coil-type heaters are suitable for a maximum temperature of 1200 deg. F. In order to heat pipes uniformly on both sides of the joint with these coil-type heaters, it is necessary to use at least two of each. In fact, it is preferable to use three coil heaters on each joint when stress relieving, so as to raise the joint to stress relieving temperature within a reasonable time, since the capacity of the coil-type heaters is considerably less than the standard type of heaters.

When preheating during welding, the two outer coils only are used; for stress relieving the third coil over the joint is added as shown on the photograph. Automatic temperature control panel for controlling preheating and stress relieving temperatures is also shown. Panel can be supplied for either single-point or multiple-point control.

During the preheating as well as stress relieving operations the coil-type heaters are covered with an insulating blanket to minimize radiation losses as much as possible.

» «

Leather Glove for Welders

★ The Industrial Gloves Co., 750 Garfield Blvd., Danville, Ill., has recently added a new chrome tanned leather welder's glove to its line of safety clothing. This new gauntlet glove, designated as No. 13115, incorporates several patented features which will be of interest to welders.

The gauntlet is made with one-piece back, extending from knuckles to top edge of gauntlet, eliminating all seams on back of hand which quite frequently rip or burn out

Chrome tanned leather glove.

on ordinary gloves. This construction provides extra leather to protect the welder's knuckles, in addition to the heavy cotton fleece which lines the entire back of the glove from knuckles to top end of gauntlet. No lining in the palm assures operator of proper "touch" at all times. Leather used is of special chrome tannage, which resists shrinkage and hardening to a maximum degree and keeps glove soft and flexible under severe temperatures.

The glove is cut on extra full pattern so that operator is assured of cool, comfortable protection at all times. The thumb seam is protected with extra leather strap. The seam attaching hand to cuff is reinforced by leather apron extending full width of glove. The manufacturer will gladly send further information and prices upon request.

» «

Lincoln "Shield-Arc" Welders with Self-Indicating Control

★ A line of "Shield-Arc" welders, said to provide greater convenience and accuracy, because of a new self-indicating dual-continuous control, is announced by The Lincoln Electric Co., Cleveland, Ohio.

These welders have both job selector and current control calibrated and equipped with dials which indicate the type of work and number of amperes for each setting. It is claimed that this development enables the welding operator to secure highest quality welds and highest possible welding speeds because he can vary both the slope of the volt-ampere curve and the amount of welding current independently to suit every job.

New Lincoln "Shield-Arc" welder of the a-c. motor-driven type.

Another feature of this welder control is that both voltage control (job selector) and current control are continuous in operation. This design provides thousands of possible combinations of voltage and current. It is claimed that this simplifies the setting of the control and accounts for a wide welding range as to types of work, welding conditions, sizes of electrodes and thicknesses of material. Being continuous, the control can be advanced or retarded in increments as fine as desired.

Other features of this new line include.

(1) A self-protected motor on all a-c. motor-driven welders which is said to permit sustained operation with large sized electrodes at high average welding currents without danger of burnout.

(2) Separate excitation of the welding generator in all types of these new welders provides the generator with a constant source of excitation which is independent of conditions at the welding arc. It is claimed that this aids in the maintenance of a steady arc for minimum spatter. Also, in the case of the engine-driven welders, it permits the use of an over-size exciter for operation of lights and tools at slight additional cost.

(3) A laminated magnetic circuit is employed in all types of welders providing minimum reluctance to the flow of magnetic flux. It is claimed that this construction quickens the response of the welding generator to changing arc conditions, resulting in greater arc stability and wider welding range.

This new line of Lincoln welders is available in a-c. and d-c. motor-driven types, belted or coupled type, and in gasoline engine and diesel engine driven types, in all standard ratings.

» «

Novel Type of Welding Control

★ Uniformly high quality welds, particularly for applications where the expense and inconvenience of x-ray do not seem justified, are claimed to be possible with the use of "Arc-Length Monitor," developed by the research division of the A. O. Smith Corporation, Milwaukee, Wis.

The "Arc-Length Monitor" is a practical development which fits into present shop practices. It helps the worker make a good weld while he is in the act of welding. Smith research has shown that, while control over voltage of itself is no definite assurance of a good weld, in nearly every case of poor welds there was a relation to the voltage involved. This situation, if controlled through definite indications to the welder during the process of welding, removes one of the main variables in welding technique. Thus it promotes higher quality welds.

The welder is informed of the length of his arc by means of two tiny bulbs, mounted inside his welding helmet, one on each side of the window through which he observes the arc. Both bulbs are normally dark at the selected voltage. The one to the right

New Product Developments

Arc Length Monitor designed to help operator hold a steady arc.

glows faintly, and with increased intensity, as the voltage increases from the selected; the one to the left responds similarly as the voltage decreases from that selected. Maximum brilliance is kept well below the point of hurting the operator's eyes or interfering with his work. The instrument itself, which contains signal lights similar to those in the welder's helmet, is placed where it can be observed by the production or welding supervisor.

The "Monitor" will be found effective where very light gauge materials are used, particularly such metals as stainless steel, requiring close control of the arc. It has also proven valuable for periodically checking experienced operators and training new operators. Experiments in Smith's welding plant show that new operators acquire ability to hold a steady arc in about one-third the usual time. The "Monitor" is also useful in minimizing controversy over test results in laboratories where it is desired to duplicate working conditions for welded specimens. Incidentally, it has the psychological effect of giving the welder an inductment to exercise extra care in his work.

» «

Soldering Iron Stand

★ Soldering irons of any size or make can be kept at a constant, adjustable temperature by the soldering iron stand, with automatic heat control, pictured here. Unit consists of a base containing a thermostatic switch which consumes no current, and a simple bracket attached on top of this base to hold the iron. The soldering iron is laid on the stand, its heat is held at a constant temperature until removed, at which time full current is automatically turned on. The unit is readily portable and is installed by merely plugging its extension cord into any outlet.

This device will, without adjustment, handle all irons up to 2000 watts in 110 or 220-volt a-c. and up to 500 watts d-c. The stand is made by American Solder & Flux Co., 4519 Wayne Ave., Philadelphia, Pa.

Soldering iron stand with automatic heat control.

New Type Steel Welding Rod

★ The Welding Equipment & Supply Co., 2727 E. Grand Blvd., Detroit, Mich., has developed a self-hardening, non-shrink tool steel welding rod for use in die and metal stamping plants. This rod, after deposit, is said to have an ultimate hardness of Rockwell 76 on the C scale, is free from porosity and practically impossible to chip.

Some of the maker's suggested uses are the repair of chipped or damaged dies without removing them from the presses; refacing punches and dies after they have been worn beyond use; facing cold trim drop forge dies; fabricating dies from cold rolled and machined steel; facing the cutting and drawing surfaces with welding wire and grinding to the desired size.

The weld can be forged and heat treated if desired. It is said that plants using the new rod in die construction are not heat treating the weld and claim that in mild steel construction they can manufacture dies for 50 to 75 per cent less than by other methods and with greater production.

The welding wires are known as Eureka No. 70-W and 71-M for arc welding and No. 70 for oxyacetylene welding.

» «

Magnetic Type Governor For Welding Generators

★ An automatic governor for throttling control of the gasoline engine driving a welding generator has been developed by E. Longley, owner of the Globe Welding Co., 700 Magazine St., New Orleans, La. This is claimed to be an automatic throttling device that will not wear out. Failure of a governor may result in overloading and burning out the generator.

This welding generator is equipped with the Longley magnetic type of governor.

In the Longley device, means is provided to open and close the carburetor of the motor by weighted plunger which is drawn to operating speed position by magnetic force when the circuit is closed by the welding operation. Normally, the plunger is held at idling speed by its weight. A solenoid, including a coil and a magnetic core, with the windings connected in the arc welding circuit, draws the plunger down to open the carburetor throttle.

The Longley automatic governor is connected in circuit on the lead or ground cables. When contact is made by the welder, it causes current to flow through the solenoid, thereby drawing the plunger which opens the carburetor. This automatic throttling of the engine furnishes sufficient power to the generator for welding operations. When the flow of current through the solenoid ceases, the magnetic field disappears, and the weighted plunger drops, closing the carburetor throttle to idling speed.

According to Mr. Longley, the device will throttle a motor down immediately to idling speed, from a speed of 500 to 600 r.p.m. Use of the device has resulted in savings of from 25 to 60 per cent in gasoline consumption and other operationg costs it is claimed. Patent has been applied for.

» «

American Optical Now Has Complete Line of Protective Clothing

★ To aid in solving industry's protective problem, the American Optical Co., Southbridge, Mass., announces a new and complete line of highest quality protective clothing, gloves, sleevelets, leggings, aprons, hats, and hoods. These products are available in a variety of materials used to protect workmen from heat, fire, acids, cuts, abrasions, etc. The materials used and the finished products are designed to give maximum comfort and protection under specific conditions.

The company also announces that special items of portection can be made to order to meet unusual requirements. A catalog is available explaining in detail the complete line of protective products and also listing the company's more than 200 branches located in the principal industrial centers.

» «

Alloy No. 1300 for Brazing

★ Alloy Specialties Co., Swissvale, Pa., is introducing Alloy No. 1300, a low melting copper-base alloy for brazing. This alloy, it is stated, starts to melt at 1150 deg. F. and is liquid at 1300 deg. F. Alloy No. 1300 is recommended for brazing copper, bronze, brass or steel. It is claimed that fatigue tests of joints made with this alloy on copper, brass and bronze parts have shown failure to occur in parent metal rather than in the joint.

Electrical conductivity is stated to be above 95 per cent of copper base, when used for copper brazing. As to corrosion resistance, it is claimed that Alloy No. 1300, being free of zinc, offers a high degree of resistance to the more common corrosion agents. Tensile strength on bronze joints will show about 50,000 psi. and 20 per cent elongation. On brass joints the alloy will give about 40,000 psi. and 45 per cent elongation. In both cases butt joints are referred to. The manufacturer has a descriptive circular describing Alloy No. 1300 which will be sent upon request.

» «

The Lomite (Calif.) Gasoline Co., plans the early construction of two welded natural gas lines across the Los Angeles river bed. One, a 16-in. line, will be for dry gas, while the other, a 10-in., will be for wet gas.

» «

The City of Andrews, Texas, is planning to build a pipeline system to supply the city with natural gas. The project will include an 11-mile welded line.

News of the Industry

Diesel Locomotive Plant Expands to Meet Growing Demand

A 300,000 sq. ft. addition (all-welded) to the diesel locomotive plant of the Electro-Motive Corp., subsidiary of General Motors, at La Grange, Ill., has just been completed. It is claimed that the plant is the most completely self-contained locomotive plant in the country. It increases the manufacturing area by approximately two-thirds to a total of approximately 14 acres. It brings under one roof complete facilities for the fabrication of diesel-powered switching and passenger locomotives, with the exception of certain castings that may be purchased more economically from outside sources.

The enlargement is the second since the plant was opened in January, 1936. A few months after the opening it was doubled in area. Employment has been increased to 2,000. The original working force was 350. The plant now has a maximum capacity of one complete locomotive per working day. The plant is now manufacturing everything not requiring the services of a foundry or heavy forge shop, including the larger sizes of General Motors two-cycle diesel engines and the generators and traction motors that are used in the transmission system.

The new addition adjoins the original plant on the west side. It is 360 ft. wide and 820 ft. long. The all-welded steel framework which made the original structure the world's largest building with all-welded steel frame was continued in the addition. Walls of almost continuous glass and monitor roof with large glass areas give the huge main room of the addition unusual daylight working conditions.

Since this plant started operation in January, 1936, sales of diesel locomotives have totaled more than $25,000,000. This represents the value of 225 locomotives with a total horsepower of 210,000. It is estimated that the total daily mileage of diesel-powered high-speed passenger trains now averages 28,000 miles. Demand for diesel-powered freight locomotives for road service is also indicated. According to H. L. Hamilton, president of the Electro-Motive Corp., 1939 will probably witness the first diesel-powered locomotive in actual freight service. It is reported that western railroads are particularly interested in diesel-powered freight locomotives because of the higher cost of coal in that section and the bad water conditions frequently encountered.

» «

Advanced Course in Welding to Be Offered by Minnesota

The Institute of Technology of the University of Minnesota, Minneapolis, Minn., in co-operation with the Northwest Chapter of the American Welding Society plans to conduct an advanced course in welding problems at its Continuation Study Center. This course will involve design, metallurgy and metallography, testing and inspection, stress analysis, economics, etc. The dates set for this course are February 9-12, 1939.

It is intended that this course shall meet the needs of engineers who desire knowledge of latest developments in welding. Since only the theoretical aspects of welding will be discussed, this course will not appeal to the welding operator. Nationally known authorities, as well as members of the faculty, will discuss various problems. Members will be furnished outlines of addresses prior to meetings. The fee for the course including pre-prints will not be over $10.00. Registration must be made not later than January 15, 1939.

Further information may be obtained from Professor Charles A. Koepke or Professor Thomas P. Hughes of the Mechanical Engineering Department.

» «

The Oxy-Acetylene Flame—Experiments in extreme heat and extreme cold in the 1890's resulted in an important industry that is seemingly based on a paradox. Oxygen is produced commercially by the liquid air process which involves temperatures as low as 310 deg. below zero. Acetylene is derived from calcium carbide, formed in an electric furnace. Burning together, these gases produce a flame which can unite or sever metals with equal ease by oxy-acetylene welding or cutting.

» «

How to Clean Safety Goggles—With constant usage, safety goggles will get dirty, just like any other article of wearing apparel. To protect workmen whose skins may become irritated or infected by dirt or other foreign matter, American Optical Co. suggests that goggles be thoroughly cleaned or sterilized at stated intervals. The following methods are recommended:

1. Wash the goggles in a hot solution of soap and water. Scrub the eyecups, lens rings and side screens with a stiff brush. If the goggles are spotted with paint or tar a 10 min. soaking in a solution of varsol will clean the surfaces. Next, soak the goggles for 30 min. in a 3 per cent cresol solution. They should then be hung on a support to dry.

Job welding shop built by welding discarded boiler flues. Photo (Harnischfeger).

2. Wash the goggles in a hot solution of alcoholic green soap, rinse in warm water and hang to dry.

3. Simply immersing the goggles in boiling water for 5 min. has been found to accomplish sterilization satisfactorily.

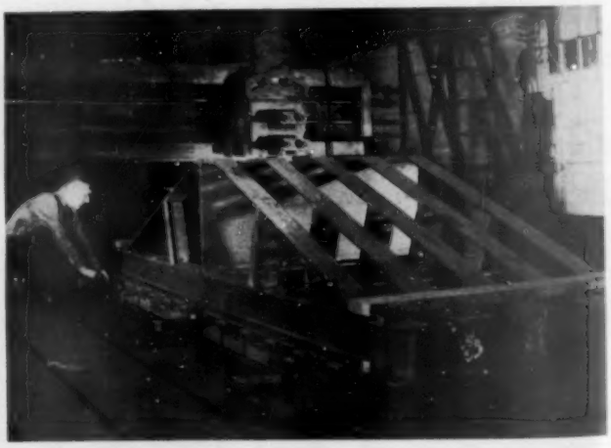
4. Soaking for 10 min. in a solution of formalin made by placing one part of 40 per cent formaldehyde solution in nine parts of water is another simple and practical method.

5. Scour the goggles to remove all dirt and then submit them to a 5 min. exposure of ultra-violet light. This is usually done in the first aid room or emergency hospital of the company when such equipment is available.

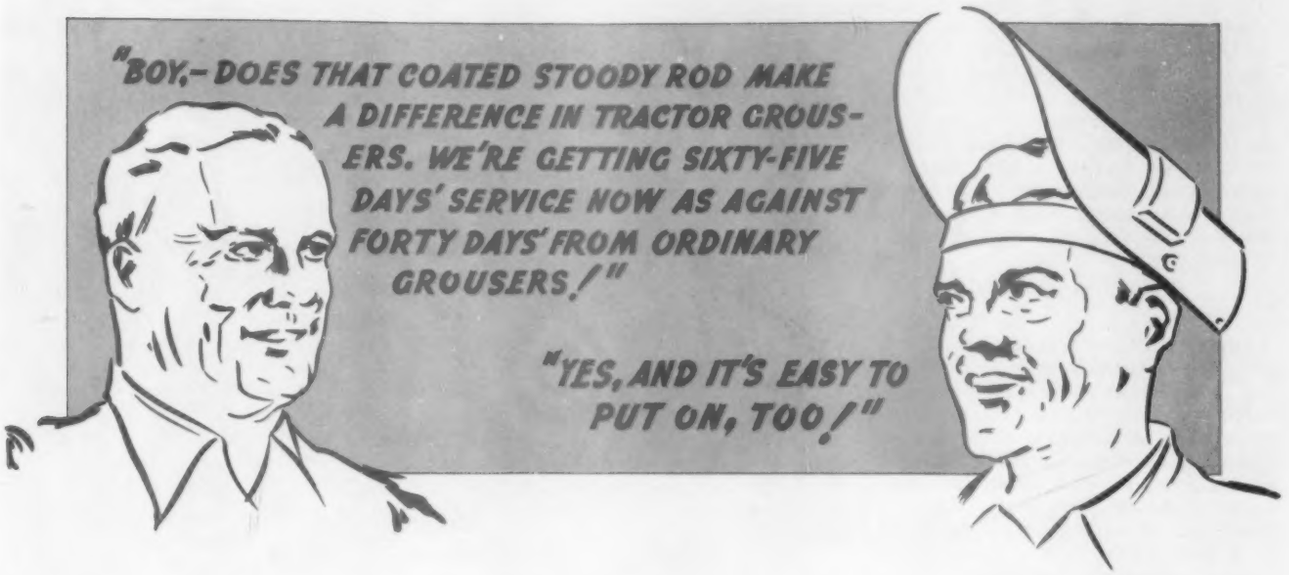
6. Another method is sterilization by a moist atmosphere of antiseptic gas, preferably formaldehyde, for a period of 10 min. at room temperature.

» «

Purdue University, Lafayette, Ind., held its 14th Annual Conference on Welding, December 1-2. Total registered attendance was 576, slightly more than last year. The following is a list of the principal speakers and subjects covered: J. D. Gordon, general manager, The Taylor-Winfield Corp., Warren, Ohio, "Applications of Resistance Welding; Hugh W. Robinson, The Monarch Machine Tool Co., Sidney, Ohio, "Flame Hardening Lathe Beds"; E. R. Fish, chief engineer, Boiler Division, Hartford Steam Boiler Inspection and Insurance Co., "Qualifying Welders"; James I. Banash, consulting engineer, International



Bridge type floor plate being machined. Fabricated by welding. Photo (Westinghouse).


"BOY,—DOES THAT COATED STOODY ROD MAKE A DIFFERENCE IN TRACTOR GROUSERS. WE'RE GETTING SIXTY-FIVE DAYS' SERVICE NOW AS AGAINST FORTY DAYS' FROM ORDINARY GROUSERS!"
"YES, AND IT'S EASY TO PUT ON, TOO!"

Tractor owners and welders everywhere agree on Stoody Self-hardening for hard-facing tractor parts. Tractor owners prefer it because it is inexpensive, yet it assures maximum traction and keeps delay and replacement costs to a minimum. Welders like Stoody Rod because it is easy to apply and allows them to turn out a "bang-up job" with the least time and effort.

The complete procedure for hard-facing tractor grousers, as well as some interesting information on costs, is contained in the October 1938 issue of the Stoody publication, Fusion Facts. Get your copy now.

STOODY COMPANY
WHITTIER • CALIFORNIA

Acetylene Association, Chicago, Ill., "Safety in Gas Welding and Cutting"; CHARLES JENNINGS, research department, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., "Distortion Problems"; ELMER ISGREN, R. G. LeTourneau, Inc., Peoria, Ill., "Arc Welding as Applied to Manufacture of Heavy Road Machinery"; W. B. BROWNING, process service engineer, Linde Air Products Co., Chicago, Ill., "Unionmelt Welding."

» «

SPECIAL TRAINING IN TECHNICAL WRITING—Answering needs of many workers for a proper mastery of the English language if they are to write for publication clearly and effectively, the Extension Division of the University of Wisconsin, at Madison, Wis., is offering a home-study course in "Composition of Technical Papers," available to individuals in any state. This course, one of a large number taught through correspondence instruction, is described as a helpful means of acquiring excellence in writing under guidance, without interruption to the daily occupation.

This instruction is adapted especially to the requirements of workers in special fields who desire to increase their proficiency in writing articles for publications, as well as business letters and reports. It presents in a few assignments the essential principles of English composition, introducing the student to an effective professional style, to the planning and arrangement of technical papers, to the important points in paragraphing, punctuation, capitalization, abbreviation, proofreading, and other phases of efficient writing in a specialized field.

Personals

GEORGE WHEELER WOLF has been appointed president of the United States Steel Products Co., effective January 1, 1939. This company is the export medium for United States Steel Corp. and is represented in all principal steel consuming centers of the world. Mr. Wolf succeeds GEORGE C. SCOTT, who is retiring from active service, but will remain with the steel products company in an advisory capacity.

Welding truss of electric stairway for Theme Building, 1939 New York World's Fair. Photo (Westinghouse).

A.W.S. Activities

MILWAUKEE SECTION, A.W.S.—C. H. JENNINGS, research engineer of Westinghouse Electric & Mfg. Co., presented a talk on the subject "Welding Practices in Europe and America" at the November 30th meeting. Milwaukee Section meetings are held at the City Club, 756 N. Milwaukee St. Mr. Jennings' address covered procedure, selection of electrodes, and characteristics of base metals and their influence on design, quality and cost of welded products.

» «

PITTSBURGH SECTION, A.W.S.—At the November 16th meeting, held in Auditorium of Mellon Institute of Industrial Research, COL. G. F. JENKS, of the Ordnance Department, U. S. Army, and senior vice president of A.W.S., talked on the subject "Application of Welding to Ordnance." Chairman L. C. BIBBER presided.

» «

PHILADELPHIA SECTION, A.W.S.—At the November 21st meeting held at the Engineers' Club, A. J. MOSES, general manager of Hedges-Walsh-Weidner Division of Combustion Engineering Co., Inc., presented the subject "Fabrication and Welding of Stainless Alloys." Mr. Moses covered the latest developments.

» «

CLEVELAND SECTION, A.W.S.—At the December 14th meeting, the Section was addressed by LEON C. BIBBER, welding engineer of Carnegie-Illinois Steel Corp. Mr. Bibber described "Impact Testing of Welded Structures." Meeting was held at the Cleveland Club.

» «

LOS ANGELES SECTION, A.W.S.—DR. DONALD S. CLARK, assistant professor, mechanical engineering, of California Institute of Technology, was the speaker at the November 17th meeting held in the Commercial Club building, Eleventh and Broadway, Los Angeles. The subject of Dr. Clark was, "Grain Size and Physical Properties of Weld Deposits."

» «

SAN JOAQUIN VALLEY SECTION, A.W.S.—"Factors in the Heat Treatment of Steels," was the subject of the principal speaker at the November 17th meeting held in the banquet room of the Padre Hotel, in Bakersfield. B. REINHOLD, president of Abegg & Reinhold Co., Los Angeles, presented the paper.

» «

NEW YORK SECTION, A.W.S.—At the Section meeting December 13, held in Room 502, Engineering Societies Building, 33 W. 39th St., EVERETT CHAPMAN, president of Lukenweld, Inc., Coatesville, Pa., presented the subject "Some Problems of Welded Steel Fabrication." Following his presentation, Mr. Chapman showed a motion picture film depicting various outstanding jobs of welded fabrication.

» «

DETROIT SECTION, A.W.S.—DR. F. R. HENSEL, consulting engineer, P. R. Mallory & Co., Inc., spoke on the subject "Spot Welding of Stainless Steel to Yellow Brass" at the December 16th meeting of the Section, held in the Colonial Room of the Detroit-Leland hotel.

» «

CHICAGO SECTION, A.W.S.—JAMES F. LINCOLN, president, The Lincoln Electric Co., Cleveland, Ohio, addressed the Section at its meeting December 16th held in the rooms of the Chicago Lighting Institute, 20 N. Wacker Drive. Mr. Lincoln's subject was "Welding and Profit vs. Price and Prejudice." Mr. Lincoln has been a pioneer in the development of arc welding. Through the James F. Lincoln Arc Welding Foundation, the advantages of welded fabrication have been effectively publicized.

» «

SAN FRANCISCO SECTION, A.W.S.—The November meeting was held on the 25th, at the Engineer's Club, 206 Sansome St., San Francisco. The speaker of the evening, DR. W. F. DURAND, professor emeritus, mechanical engineering, Stanford University, gave an interesting talk on "Subject Matter Pertaining to General Welding." Dr. Durand is a consulting engineer who has been prominently identified with various welded penstock installations. Chairman N. F. WARD presided.

Future Meetings

January 23-27, 1939

American Institute of Electrical Engineers, 33 West 39th St., New York City. Annual Winter Convention in New York City.

February 23-25, 1939

American Society of Mechanical Engineers, 29 West 39th St., New York City. Spring Meeting at New Orleans, La.

March 8-10, 1939

International Acetylene Association, 30 E. 42nd Street, New York City. Thirty-ninth annual convention will be held at the Rice Hotel, Houston, Texas. Complete program announcement will be carried in the February, 1939, issue.

Trade News

THE HARNISCHFEGER CORP., Milwaukee, Wis., announces appointment of DIXIE MILL SUPPLY CO., with offices in New Orleans, La., and Shreveport, La., as exclusive agents for P&H-Hansen arc welders and Smoothare welding electrodes for the State of Louisiana.

» «

CRANE CO.'s Division of Engineering and Research held open house November 8, 9 and 10, at its enlarged laboratories at 42nd St. and South Kedzie Ave., Chicago. The staff of 255 persons, headed by DR. L. W. WALLACE, director, played host to scientists, educators, research men, engineers, business

THE FLEXARC WELDER

Constant, stable arc assured by the Arc Watchman

No nuisance gadgets

Unlimited number of current steps. With proper arc length, voltage adjustment is automatic

Single pre-set current control

Westinghouse

"This talk about constant current is the bunk. It'll pile, it'll splatter, it'll drop down every time."

"Not with the Flexarc."

"They're all alike."

"Not this machine—it has a new principle of control—the Arc Watchman."

"What's that do?"

"It keeps your current just where you set it—to the hairline, hour after hour."

"How can you prove it?"

"On the job—but if you want to see first, put an ammeter at the end of your cable—the needle will never vary."

"Sounds too good to be true."

"It is though—try it and then you'll know."

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PA.

J20647

WESTINGHOUSE FLEXARC WELDER

executives, business paper and newspaper editors.

Tour of the Division of Engineering and Research included the metallographic and spectrographic laboratories, photographic laboratories, radiographic laboratory, material testing laboratory, creep of metals laboratory, physical and chemical laboratory, ceramics laboratory, welding laboratory, process metallurgy laboratory, ceramics smelting, works laboratory, design and development department, industrial products laboratory, offices and library. Following inspection of laboratories, guests were offered the option of taking any one of four conducted tours of the Chicago Works.

» «

New England Welding Supply Co., 405 Chapel St., New Haven, Conn., has been appointed distributors of Airco oxygen and acetylene gases and the complete line of Airco-DB oxy-acetylene welding and cutting apparatus and supplies. These products, as well as Airco electrodes, National carbide, and Stoody hard-surfacing rods will be maintained in stock. They will also handle Wilson arc welders.

» «

Carnegie-Illinois Dedicates New Plant —The new Irvin Works of Carnegie-Illinois Steel Corp., major project in the modernization program of United States Steel Corp., was formally opened December 15. Dedication of the plant, known locally as "the mill on the hill," included an inspection trip by several hundred industrial leaders and corporation officials. Chief units of the plant are an 80-in. hot strip mill, an 84-in. tandem cold reducing sheet mill, and a 42-in. tandem cold reducing tin mill. These are supplemented by necessary annealing furnaces, pickling and tinning departments. The mills are electrically operated and have an annual capacity of 600,000 tons.

» «

Metal & Thermit Corp., 120 Broadway, New York City, has recently appointed the following new jobbers: Rome Iron Mills, Rome, N. Y.; Rochester Equipment Co., Rochester, N. Y.; Hopper Machine Works, Bakersfield, Calif.; Western Welder Corp., Duluth, Minn.; The Mine & Smelter Supply Co., Denver, Colo.

» «

Stulz-Sickles Co., 134 Lafayette St., Newark, N. J., has recently appointed the following distributors: Austin-Hastings Co., Inc., 226 Binney St., Cambridge, Mass.; Southern Iron & Equipment Co., Hemphill Ave., Atlanta, Ga.; and Strahle-Johnson Supply Co., 1300 Broad St., Chattanooga, Tenn.

Current Reviews

Speed of Stretching Affects Yield Point —E. A. Davis, research engineer for the Westinghouse Electric & Manufacturing Company, described some of the peculiar properties of steel in a paper presented before The American Society of Mechanical Engineers during its recent annual meeting in New York, December 5-9, 1938. Between no load and the ultimate stress on a piece of mild steel are two points at which very little change in stress produces a lot of deformation. These are known as the upper and lower yield points of the metal, and there is nothing very complicated about it, except that yield points are erratic things. One test may determine them nicely, but if an identical piece of steel is loaded just a little faster than the first piece, the yield points will not occur at the same stresses. This peculiarity of steel was discussed at some length by Mr. Davis. His tests included observations on the shapes of different specimens, upon the speed of stretching, and upon the rate of loading in their relation to the yield points of mild steel.

» «

"Oxy-Acetylene Welding"—This book has been revised by Morgan H. Potter, of the Dunwoody Industrial Institute, St. Paul, Minn. This is a cloth bound, 125 page book, written in "how-to-do-it" style. It is well illustrated and carries a rather complete index at the back.

Scope of the book is indicated by the principal subject headings: Oxy-acetylene process; Technique of oxy-acetylene welding; Welding of different metals; Steel welding; Cast-iron welding; Welding at vertical and overhead positions; Pipe welding; Bronze welding; Hard-surfacing; Silver soldering; Oxy-acetylene torch; Malleable iron welding; Welding white metal or die castings; Aluminum welding; Copper welding; Brass and bronze welding; Cutting and lead burning; Welding in automobile repair work; Design of jigs for oxy-acetylene welding; Costs of welding.

American Technical Society, 5800 Drexel Ave., Chicago, is the publisher. The book retails for $1.25.

Foreign News

British Standardize Electrode Shanks The British Standards Institution announces that it has drawn up the British standard specification for the shanks of electrodes for spot-welding machines. These machines are constantly being installed and, in order that the output may be maintained, it is desirable to be able to change over rapidly from one machine to another in the event of a failure of one machine. This has often been difficult owing to the differing forms of electrode holders adopted by various welded manufacturers.

To overcome this difficulty the new specification prescribes the form and dimensions of the hole in the electrode holder and of the shank of the electrode which fits into the hole. It is realized that in the case of heavy pressure machines it is desirable to reverse this method of attachment and provide the arm of the machine with a spigot which fits into a hole in the electrode. In such cases the form and dimensions of the spigot and the hole should be the same as that described in the specification. The taper specified has been selected as a result of careful tests.

Progress of British Welding

Sir Frank Smith in an address at the Institute of Welding, London, annuall dinner, stressed the importance of welding in engineering. He pointed out that the modern steel automobile body is essentially a product of welding and that it could hardly be produced by any other means. In shipbuilding, he declared, more than 75 per cent of a warship like H.M.S. "Ark Royal" is constructed by welding. As many as 190 welders were employed on this ship during construction. Sir Frank also quoted the part played by welding in producing longer rails for the railroads. In conclusion, he emphasized that welding enabled industry to obtain maximum benefit from the new materials which metallurgical science is producing.

Sir William J. Larke, chairman and president of the Institute, stated that the Institute, although a comparatively young body, has already made substantial progress. During the past year its membership has increased more than 25 per cent and is now nearly 1,300. In addition to the main research committee, the Institute now has five principal committees and 17 sub-committees, each investigating a separate phase of the problems of welding.

» «

French Develop Methods of Reconditioning Worn Surfaces

A French welding concern (La Société l'Air Liquide, Paris) which during the past year or two has developed to a high stage of efficiency methods for the reconditioning of worn rail ends by oxy-acetylene welding, has now extended the process to the building up of worn surfaces in machine and engine components.

In most cases the deposited metal possesses harder wearing properties than the original material, thus prolonging the resistance to wear of the reconditioned part. The company has evolved a series of weld metals, both ferrous and non-ferrous, suitable for a wide variety of applications. Several noteworthy examples of work done with these materials are described in a report written by M. Michaud, one of the society's technologists.

For example, badly worn wobblers of rolling mill spindles and pinions, which are usually made of medium carbon steel, are shown to have been successfully reconditioned by means of high-carbon welding rod containing from 1.0 to 1.2 per cent carbon. This metal is deposited, using a slight excess of acetylene in the flame, after preheating the piece in a portable furnace.

The requisite thickness of steel is deposited in successive layers, each of which is subjected to peening with a light hammer while at red heat. With the help of a template, a skilled operator can gradually bring the piece up to the required dimensions and shape. It is asserted that whereas the Brinell hardness number of the original material is of the order of 130 to 150, that of the reconditioned surface ranges from 200 to 250.

Worn railroad car axle journals are repaired by depositing a nickel-steel, called Tostic, followed by machining to shape. The new surface will take a high polish. A typical application of an air-hardening steel welding rod, called Alchrome, the composi-

tion of which is not disclosed, is in connection with the repair of worn links of haulage chains, 2 kilometers in length, used in a phosphate mine. Fifty links were treated per 8-hour day, each link receiving two deposits. The weight of Alchrome deposited averaged 60 grammes per link.

In his report Mr. Michaud also refers to the coating of the valve seats and seating rings of high-power internal combustion engine exhaust valves with Stellite. He also refers to the use of tungsten carbide (Haystellite) in the reconditioning of cutting edges of rock drills.

For the repair of worn bearings, slides and runner blades of cast steel water turbines, which are often pitted and even perforated as a result of cavitation, the use of Tobin bronze rod is advocated. Brinell hardness of the repaired surfaces ranges from 80 to 95, according to composition of the weld metal. The metal deposited has a brassy yellow color, but if a steel-white coating is desired, a special nickel-silver welding rod may be used. Deposits of this material, called Arox, have a Brinell hardness varying from 110 to 120.

» «

Welded Boilers in Germany

In a lecture on German boiler construction, recently delivered by F. Weber, Dusseldorf engineer, at the Institution of Mechanical Engineers, London, the methods employed by German industry were reviewed. Dealing with stationary types, Mr. Weber stated that modern flue boilers were now generally constructed with arched crowns and corrugated tubes. In recent designs the heating of outer boiler walls has been abandoned. The development of water-tube boiler design has been marked by increases in working pressures, temperatures and outputs. Twenty years ago the average pressure of water-tube boilers in Germany was 15 atmospheres; today it is 50 atmospheres, and the highest pressure is 150 atmospheres. The average output 20 years ago was 7.5 tons, and this average has now risen to 35 tons, while the largest water-tube boiler operating in Germany has an output of 160 tons of steam per hour.

Dealing with boiler materials, the lecturer pointed out that there has been a careful reorganization of material inspection, analysis, and shop methods. Welding is now freely employed. Success has attended the introduction of the Roeckner process of rolling seamless drums. Riveting has been almost entirely abandoned, and welding is employed on drums for working pressures up to 80 atmospheres, while solid forged and rolled drums are employed for all pressures up to 200 atmospheres.

In regard to hydraulic tests, the official regulations have been awarded to do away with the double pressure test, now considered harmful, and for welded drums a test pressure of 1.3 times that of the working pressure is used. With seamless drums the test ratio is 1.1 times.

» «

Welding Advances Shipbuilding

The progress of welding in the shipbuilding and ship repairing industries is the subject of a survey in the annual report of Lloyd's Register of Shipping, just published in London.

Less than ONE INCH of EASY-FLO makes this reliable joint

EASY-FLO has the lowest flow point (1175°F.) of any alloy producing joints of high strength. It economically joins steel, stainless steel, Monel, Inconel, Everdur, copper, brass, bronze, nickel and other copper-nickel and chrome-nickel alloys. If you have a metal joining problem, try it, or send us details —we'll be glad to help work it out.

THE brazing of this oil float is typical of the small amount of EASY-FLO it takes to make sound, ductile, leak-proof joints.

Production records in this case show that 75 joints, 2.36" in circumference, are made from one ounce (66") of 1/16" EASY-FLO wire.

The actual EASY-FLO cost is but six tenths of a cent per joint. One operator brazes 70 floats per hour.

Complete costs, including EASY-FLO, HANDY FLUX, gases and labor, are only 1.69 cents per joint.

There are hundreds of production jobs like this where Low Temperature Silver Brazing with EASY-FLO has proved that it is LOW COST BRAZING.

If you have ferrous or non-ferrous metals to join, find out what EASY-FLO can do for you. Write us for full details—ask for Bulletin 10-12W.

HANDY AND HARMAN · 82 Fulton St., New York

The report states that the use of electric welding continues to increase in the United Kingdom, and its employment in the construction of lower decks, oil fuel bunkers, etc., has become a standard practice in several yards. In one large passenger vessel now under construction all decks and topsides are welded. In another vessel all the decks (which are of high elastic-limit steel) are being welded. Two tankers in which the entire structure of the oil tanks was welded by an automatic process, are now in service.

The number of improved electrodes continues to increase, and the list now contains the names of 172 electrodes, of which 129 have been approved as complying with the special requirements for use in parts of primary importance in the structure of the vessel. Electrodes for the automatic electric arc process and the carbon arc process have also been approved.

Dr. James Montgomery, chief ship surveyor, visited the United States during the year. He witnessed the operation of the welding process in shipbuilding and repair yards, especially in relation to its use on an extensive scale in the building of large tankers, and he discussed with shipbuilders and welding experts the problems associated with application of the automatic welding process to shipbuilding.

For engineering purposes the use of welding continues to increase, the report adds, and many engine manufacturers now fabricate steelwork parts, such as bedplates, and frames, by welding together ribbed sections and plates. A large number of boiler drums, gas and liquid receivers, and similar pressure vessels having welded joints were constructed during the year.

An increasing number of concerns in Britain and other countries have submitted details and typical products of their welding organizations for the consideration of the Committee of Lloyd's Register, in order that their names may be added to the list of firms approved for Class I welded pressure vessels.

Recent Patents

Automatic Arc Welding System

2,132,479. Claude J. Holslag, South Orange, N. J., assigned to Electric Arc Cutting & Welding Co., Newark, N. J. Filed Dec. 22, 1936. Issued Oct. 11, 1938. An automatic arc welding system containing a source of welding current and means for feeding an electrode to the work. The work constitutes the other electrode. The device has a mechanism for controlling the feed of the welding electrode in relation to the work, that mechanism including an electromagnetic device having two windings, one winding being energized by a voltage derived exclusively from across the arc, while the other winding is energized by a cooperative balancing voltage derived from the welding current but distinct from the current through the arc.

» «

Hand Shield for Welding Apparatus

2,132,570. Domenic Leone, Baltimore, Md. Filed Oct. 12, 1937. Issued Oct. 11, 1938. A shield is described for protecting the hand of the operator from the intense welding heat and from particles of flying molten metal. The shield is composed of a central circular supporting member having an opening substantially through the center and a conical collapsible shield having its smaller end secured to the outer rim portion of the central supporting element. Through the central element the handle member of the welding apparatus is placed. The shield is made of a tough non-burning flexible material and completely protects the hand of the operator.

» «

Welded Joint

2,132,575. Bolton C. Moise, Pittsburgh, Pa., assigned to National Tube Co., N. J. Filed June 23, 1937. Issued Oct. 11, 1938. In joining together tubular sections which convey fluids under high pressure and are subject to great longitudinal stresses, such as for instance, oil well casing, it is necessary to have joints which are fluid-tight and sufficiently strong to withstand high stresses. In this patent, the inventor provides a number of axially placed slots in the extremity of the expanded section, these slots extending through the wall of the section and having their outer ends of reduced width. The section to be inserted is provided with a recess opposite each of the slots in the first section. A continuous mass of weld metal is then applied extending around the edge of the first section and into the spaced axially extending slots.

» «

Method and Apparatus for Vertical Welding

2,132,975. Perry E. Shaver, Philadelphia, Pa., assigned to Sun Shipbuilding & Dry Dock Co., Chester, Pa. Filed Feb. 21, 1935. Issued Oct. 11, 1938. In the construction of elongated articles, such as heat transfer devices, including stills, condensers, and the like, difficulties are encountered in welding a number of fins simultaneously. This is due to the flexibility of long tubes and fins which prevents them from being held rigidly during the welding operation. Moreover, the application of heat to one side, as occurs when only one or two welds are made at a time, brings the tube locally to a high welding temperature, causing such warping as to materially interfere with proper contact between the two parts to be welded and to render the tubes useless because of lack of straightness after welding. The patentee overcomes these difficulties by arranging the pieces to be welded in a vertical position and suspending the pieces by their upper ends. The pieces are then moved vertically in the direction of their lengths past fixed welding apparatus.

» «

Joining Bi-Metallic Articles

2,133,058. Sumner E. Paine, McKeesport, Pa., assigned to National Tube Co., N. J. Filed Feb. 4, 1936. Issued Oct. 11, 1938. A method of joining bi-metallic articles composed of stainless steel and basic steel which includes positioning the edges to be joined, the like layers of the articles being oppositely disposed, placing a metallic filler between and in contact with the positioned edges, the filler being of substantially the same composition as the metal of the stainless steel layer and having a surface which is substantially flush with the outer surface of the layer of stainless steel, placing a backing-up bar of high heat conductivity against the flush surface of the filler and the adjacent stainless steel surfaces, and welding the metallic filler to the positioned edges of the articles from the basic steel side without fusing the surface of the filler.

» «

High Frequency Welding

2,133,152. Iwane Schigyo, Tokyo, Japan, assigned to General Electric Co., N. Y. Filed May 2, 1935. Issued Oct. 11, 1938.

Ryerson a dependable source for Welding Rod

• Ryerson Engineers have developed a series of rods that are outstanding for Quality production. More than twenty types, including both electric and gas rods, are carried in stock. Whether you need a shielded arc type for production work or a stainless steel rod you can be sure of immediate shipment... *Write for Bulletin which gives complete data.*

ELECTRODES

Ryerson
Shielded Arc Type
No. 215
Shielded Arc Type
No. 216
Shielded Arc Type
No. 217
Green Processed No. 18

Ryerson
Green Processed No. 6
Bare Mild Steel
Brown Processed
White Flux Coated
High Carbon White Flux Coated
Blue Flux Coated

GAS RODS

3½% Nickel Steel
High Carbon Bare
No. 2110

Ryerson
3½% Nickel Steel Flux Coated
High Manganese Steel
Hard Surfacing
Allegheny Stainless Flux Coated
Allegheny Stainless No. 44

Tobin Bronze
Allegheny Stainless Bare
Hard Filler

Copper Coated No. 206
Copper Coated No. 210
Cast Iron

JOSEPH T. RYERSON & SON, Inc., Chicago, Milwaukee, St. Louis, Detroit, Cleveland, Cincinnati, Buffalo, Boston, Philadelphia, Jersey City

An apparatus for arc welding which contains a pair of arc-forming electrodes, a device for delivering low-frequency current to the electrodes, means for delivery high-frequency current to these electrodes, and a relay energized by the low-frequency source to control the high-frequency source, whereby interruption of the low-frequency current causes interruption of the high-frequency current.

» «

HEAT TREATMENT OF WELDED JOINTS

2,133,926. SAMUEL H. RANSOM, JR. and GEORGE C. FAIRBAIRN, Port Arthur, Texas, assigned to The Texas Co., N. Y. Filed June 13, 1936. Issued Oct. 18, 1938. A method of annealing a welded joint formed by metal deposited between steel members, one of which is tubular. The method is particularly adapted to steel alloys containing about 4 to 6% of a metal selected from the group of chromium and molybdenum. In the process the temperature of the weld and adjacent portions of the steel members are raised to about 1600 deg. F. and maintained at this temperature for a period sufficient to relieve all stresses in the joint or adjacent steel. Thereafter the temperature is reduced gradually to about 1350 deg. F., maintained at that temperature for several minutes, and then reduced to approximately 1200 deg. F.

Trade Literature

MODERN ENGINEERING CO., 3413 Pine Blvd., St. Louis, Mo., has issued its 1939 "Meco" catalog, containing complete information on the entire "Meco" line of oxy-acetylene welding and cutting equipment.

» «

M.S.A. COMBINATION SKULLGARD welding shield is the subject of Mine Safety Appliances Co. Bulletin No. CE-6, now ready for distribution. It is stated that the comfort and protection of a standard car-type Skullgard is combined in this unit with the latest model one-piece welding shield, which pivots to up or down positions at will. The Skullgard may easily and quickly be detached from the shield and worn separately for other work when desired.

Copies of the bulletin may be obtained free on request to Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.

» «

NEW LINCOLN "SHIELD-ARC" WELDER—A well illustrated and comprehensive 20-page booklet gives the story of the new arc welding technique of the Lincoln "Shield-Arc" welder with self-indicating dual continuous control.

This bulletin, printed in two colors, discusses in detail the operation of welder control, interpreting the electrical performance in terms of welding results. It explains the need for control of the slope of the volt-ampere curve in order to vary the type of welding arc to suit various working conditions, types of joints and classes of work. It shows how this new welder provides control of the type and size of welding arc and gives the operator an accurate indication of the setting of the welder both as to type of work and number of amperes.

This bulletin also lists and explains the 31 features of performance and construction of "Shield-Arc" felders and gives statements from users relative to specific advantages. Copies of this new bulletin are available from The Lincoln Electric Co., P. O. Box 5758, Cleveland, Ohio.

» «

TWO NEW AIRCO CATALOGS—Air Reduction Sales Co., 60 East 42nd St., New York City, has published two new catalogs (price lists separate), covering its entire line of Airco welding and cutting apparatus and supplies.

Catalog 22, which contains 32 illustrated pages, depicts hand welding and cutting torches and tips, pressure regulators, fluxes, rods and other supplies. Eight complete outfits covering the entire range of industrial uses are shown, and in addition will be found valuable information and illustrations of portable oxygen and acetylene manifolds, circular cutting attachments, cylinder trucks, torch extensions, etc.

Catalog 21 is designed to assist the large user of oxy-acetylene equipment and electric arc welding machines. It contains 64 pages which show, in addition to those items in Catalog 22, additional information dealing with acetylene generators, industrial gases, and oxy-acetylene machines. There are also several pages devoted to pipeline safety devices, two pages on National Carbide, and two on Wilson arc welders.

» «

"METHODS FOR FABRICATION OF LUKENS NICKEL-CLAD STEEL" is the title of Bulletin T-4 just issued by Lukens Steel Co., Coatesville, Pa. A similar bulletin is available from the International Nickel Co., 67 Wall St., New York City. Information in this bulletin is presented primarily for the benefit of the fabricating shop and the welder. It is well illustrated, with simple sketches showing joint design and welding technique.

» «

LINCOLN OFFERS BULLETIN ON WELDING PROCEDURES—Procedures for producing all types of welds in mild steel, for welding all metals used to any extent industrially and for applying surfacing metal to meet any type of wear-action in service, are given in a new bulletin just issued by The Lincoln Electric Co., Cleveland, Ohio.

The new bulletin, profusely illustrated, 36 pages, 8½ by 11 in., and printed in two colors, gives complete procedures for: flat, vertical or overhead welding in mild steel; single or multiple-pass welding and for poor fit-up in mild steel; flat welding of fillet welds in mild steel; flat welding of deep-groove joints in mild steel; flat welding of deep-groove joints in high-tensile steels; general welding of high-tensile steels; welding of light-gauge steel, 18-8 and 25-12 stainless steels, 4-6 chrome steels, high manganese steel, cast iron, aluminum, bronze, brass and copper; for surfacing to resist moderate shock and abrasion; rolling or sliding abrasion-resisting welds; and for making tool steel cutting edges on ordinary steel and rebuilding worn tools and dies.

The procedures, which cover all types of welding, include: recommended current ranges and arc voltages; suggestions regarding arc length, polarity of welding current, distance to hold electrode from work, cleaning beads, welding up or down, use of wide and narrow beads, peening to increase quenching, weaving the electrode, etc. Properties of welds produced in various metals are given and typical welding applications are illustrated.

Of value to all users of welding, Bulletin 401-A is available on request from The Lincoln Electric Co., Cleveland, Ohio.

DOUBLE WILLSON double-duty
CHIPPING AND WELDING GOGGLES
Consult your authorized Willson Distributor for information on other Willson Welding Goggles, Helmets, and Handshields.
THE CHIP-WELD GOGGLE, STYLE DC50, combines the protective qualities of two separate goggle types—chipping and welding. Fifty mm. clear Super-Tough lenses furnish strength against impact of flying particles, and hinged frames which may be readily raised are furnished with 50 mm. Willson-Weld lenses for protection against injurious light rays. Goggle cups are molded to fit the curves of the face and may comfortably be worn over correction spectacles.
DOUBLE WILLSON
PRODUCTS INCORPORATED
READING, PA., U.S.A.

Classified Section

ADVERTISING RATES

Help Wanted — 75c per line, minimum 4 lines. Jobs Wanted — 4 lines free. Other Ads — $1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

PLEASE NOTE—All replies to classified ads with blind address must be addressed as follows: Dec-(X), The Welding Engineer, 608 S. Dearborn St., Chicago, Ill.

FOR SALE

BARGAINS—Demonstrator Arc Welders. Gasoline and electric drive. 30 days' trial. Easy terms if desired. Write Hobart Welder Exchange, Box U-1281, Troy, Ohio.

FOR SALE—Complete low-priced welding and cutting outfits. Guaranteed. Soldering and brazing torches. Dependable repair service on all makes of equipment. Gasweld Equipment Co., 625 W. Jackson Blvd., Chicago, Ill.

FOR SALE—2500 ft. slightly damaged, practically new, rubber-covered super-flexible welding cable. No. 2 size for 200-amp. welders only 12c; No. 1 size for 300-amp. 16c ft.; No. 1/0—20c ft; No. 2/0—24c ft.; also 100-amp. Lincoln vertical welders $100; 300-amp. Lincoln-Buda gas engine welder $300. Address Dec-8, The Welding Engineer.

HELP WANTED

SALESMAN WITH FOLLOWING IN WELDING TRADE—To carry several specialties as a sideline. Liberal commission basis. Every welding shop a prospect. Address Dec-3, The Welding Engineer.

SALES ENGINEER—Established mid-western distributor with complete well known lines arc welding equipment, electrodes and supplies desires services of experienced sales engineer with following in Illinois. Address Dec-7, The Welding Engineer.

POSITION WANTED

COMBINATION WELDER—Age 26, welding school graduate. 2 yrs. exp. in own shop. Prefer production work. Sheldon C. Heck, Lehigh, Iowa.

COMBINATION WELDER—Desires permanent connection with construction company, U. S. or foreign. References. Address Dec-2, The Welding Engineer.

ARC WELDER—2 yrs. exp. all positions, graduate Hobart Welding School. Age 24, married. Willing go anywhere in U. S. Verl C. Lontz, 103 E. Graham St., Kentland, Ind.

COMBINATION MTCE. WELDER—28 yrs. old, 3½ yrs. exp. on mtce. welding. Will go anywhere. Prefer So. America or Australia. Joe J. Turkal, P. O. Box 494, Bessemer, Mich.

COMBINATION WELDER—16 yrs. exp. in plate shop, bit shop, job shop, refinery, oil fields and pipelines. Age 33, married, free to travel. Have trailer house. Wish outside work. W. E. Padget, 1481 S. Irving St., Denver, Colo.

COMBINATION WELDER—2 yrs. exp., can weld in any position. Age 27. Free to travel. Willing to do demonstration work. Also some advertising exp. Address Dec-1, The Welding Engineer.

WELDER—23 yrs. old. 7 yrs. arc and acetylene welding. Production, mtce. and job shop exp. Would like steady position. Can furnish A-1 references. Willing go anywhere. Edmund Pices, 337 S. Orchard St., New Bedford, Mass.

WELDER FOREMAN—12 yrs. exp. heavy construction. Hartford qualified on high-pressure pipe. Can furnish references. Address P. O. Box 42, Wedron, Ill.

ARC AND ACETYLENE WELDER—Age 24. Welding school graduate. Desire steady employment. Willing to travel. Fred Schroeder, 2546 N. 7th St., Milwaukee, Wis.

WELDING ENGINEER—8 yrs. exp. supervising code and miscellaneous welding. 6 yrs. exp. manufacturing and selling electrodes. Seeks connection with right organization. Address Dec-4, The Welding Engineer.

COMBINATION WELDER—10 yrs. exp. on sheet metal, plate work, cast-iron. Also repair work. Willing go anywhere. Age 29. Address Dec-5, The Welding Engineer.

PRODUCTION MANAGER—12 yrs. exp. production management, purchasing, stores control in metal-working plants. 10 yrs. exp. job welding shop, gas and elec. Familiar all phases shop operation. Would consider sales position. Address Dec-6, The Welding Engineer.

ARC WELDER—2 yrs. exp. general mtce. heavy steel and cast iron —C. I. up to 2 in. thick and steel up to 3 in. Also cast-iron boiler sections. Age 27, single, Lincoln school graduate. Willing to travel. John Pustek, 1217 Fred St., Whiting, Ind.

GREATER PROFITS THAN EVER BEFORE

Use Wiese World Brand high carbon abrasion resisting steel reclaiming units for plow shares, planter runners, cultivator shovels, sweeps, and other farm implements.

U. S. Patent 2,013,818—2,051,234—
Canadian Patents 365,296 and 369,723.

ELECTRIC WELDED

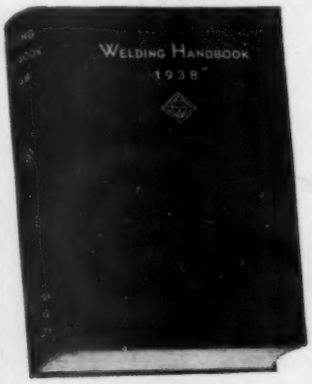
Write for 1939 Catalogue

NEW PROCESS PLOW WELDING COMPANY, Perry, Iowa
Original Manufacturers of Plow Reclaiming Units

You need this text . . .

WELDING HANDBOOK

of The American Welding Society



A concise volume prepared to cover (1) Fundamentals of the various welding processes, (2) Materials used and testing methods, (3) Applications of welding. Supplemented by data on metal cutting and processes closely allied to welding and cutting.

Not the writing of one man, but the combined knowledge of 90 authors, each an authority in the field he covers. Each author's work is further reviewed by at least 5 others, all experts.

Concise, complete, authentic. Cloth, 1200 pages and index, 6 x 9 inches; published by American Welding Society; supplied by The Welding Engineer, Chicago.

$6.00 in U. S.
$6.50 abroad

PARTIAL LIST OF CONTENTS

PROCESSES—A.C. or D.C. arc, manual and automatic; atomic hydrogen; gas, resistance; thermit; soldering and brazing; hard surfacing; metal spray; flame hardening; stress relieving.

MATERIALS—Metallurgy; carbon and low alloy; chromium steels; chrome-nickel alloys; copper, aluminum and nickel and alloys of each.

TESTING—Qualification procedure; non-destructive; fatigue and others.

APPLICATIONS—Jigs and fixtures; ships; pressure vessels; boilers and pipes; machine structures; buildings and bridges; railroads; maintenance.

Send Your Order Today

THE WELDING ENGINEER PUBLISHING CO.
608 South Dearborn St. Chicago, Illinois